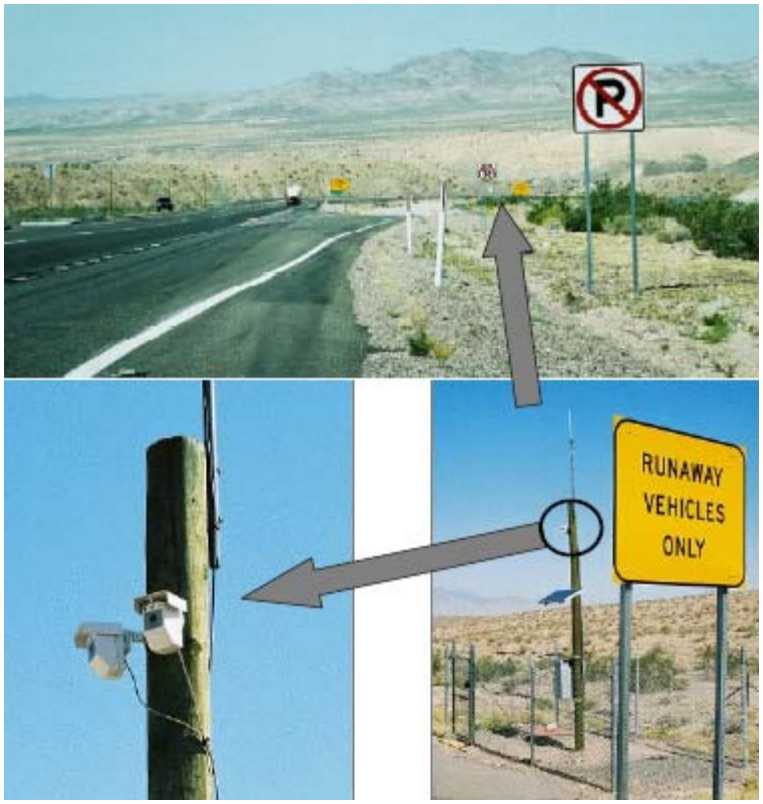
Arizona Department of Transportation

ARIZONA TRANSPORTATION RESEARCH CENTER

FY 2006 Research Program



Estimated State Planning & Research Program
Part II – Research

Arizona Department of Transportation
Arizona Transportation Research Center
2739 East Washington Street, Mail Drop 075R
Phoenix, Arizona 85034-1422
Phone (602) 712-3134 · Fax (602) 712-3400

Mailing Address
206 S. 17th Ave.
Mail Drop 075R
Phoenix AZ 85007

In cooperation with:

U.S. Department of Transportation
Federal Highway Administration

SPR-PL-1(69)
Fiscal Year 2006
(July 1, 2005 – June 30, 2006)

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Projects by Emphasis Area

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Environment		
495	*A Field Study of Particulate Emissions*	1
540	*Evaluation of Wildlife/Vehicle Collision Mitigation, SR-260*	4
555	*Determination of Atmospheric Effects on Highway Noise Propagation*	6
572	*Identification and Evaluation of Innovative Noise Barrier Designs*	9
576	*US-93 Big Horn Sheep/Highway Collision Mitigation Study*	11
584	*Survey of Traffic Noise Reduction Products, Materials and Technology*	13
587	*Evaluation of Salvage and Replanted Native Plants on ADOT Projects*	15
588	*Effectiveness of Bighorn Sheep Underpasses, SR-68*	17
589	*Determination of 404 Permit Requirements and Habitat Restoration Requirements*	19
600	*Evaluating the Effectiveness of Microbe Application to Petroleum Spills at Crash Sites*	21
601	*Cost Evaluation of Cross-Border Truck Emissions Testing using Heavy Duty Remote Sensing (HDRS) Equipment*	23
602	*Sampling and Analyses of Storm Water Runoff*	25
603	*Continued Evaluation of Measures to Minimize Wildlife-Vehicle Collisions & Maintain Wildlife*	27
Intelligent Transportation Systems (ITS)		
473	*Arizona Intelligent Vehicle Research*	29
557	*Railroad & Highway Crossing Cooperative Signal Control*	31
569	*Transportation Communications Interoperability Phase 2 – Resource Evaluation*	33
585	*Evaluation of Snowplow-Simulator Driver Training*	35
595	*Real-Time Adaptive Ramp Metering: Simulation and Implementation*	37
604	*Real-Time Adaptive Ramp Metering: PHASE 2– Implementation and Enhancement*	39

Maintenance

371	*Maintenance Cost Effectiveness Study*	41
459	*Environmentally Acceptable Cold Mix for Statewide Use*	43
500	*Aggregate Sources in Northern Arizona*	45
520	*Maintenance Repair Procedures for Bridge Decks*	47
533	*Development of Materials for Repairing AR-ACFC Surfaces*	49
536	*Improved Snow Plow Headlight Visibility and Reduced Driver Fatigue*	51
607	*Analysis of and Recommendations for Alleviating Roadway Surface Damage Caused by Snowplow Activity*	53

Materials and Construction

396	*LTPP and Other Test Section Management and Evaluation*	54
402	*Development of Performance Related Specifications for Asphalt Pavements*	55
460	*Evaluation of Cold In-Place Recycle Methods*	57
471	*Specific Applications of Shotcrete to Enhance Rock Mass Stability*	60
491	*Cost Benefit of Continued Pavement Preservation Strategies*	62
518	*Reducing the Development Cycle Time for Construction Process*	64
524	*Mix Design and Product Specifications for Asphalt Rubber Concrete*	66
574	*Use of NDT Equipment for Construction Quality Control of Hot Mix Asphalt Pavements*	68
575	*Concrete Aggregate Durability Study*	70
577	*Pavement Noise Study*	72
590	*Performance Related Pay Factors for Asphalt Concrete*	74
605	*Investigations of Environmental Effects on Freeway Acoustics*	76
606	*Implementation of the Mechanistic-Empirical (M-E) Design Guide for Arizona*	78
608	*Development of Rational Pay Factors Based on Concrete Compressive Strength Data*	79

Planning and Administration

528	*Damage Done to Arizona highways by Overweight Vehicles*	81
534	*Developing an Electronic "Signature" Process for ADOT*	83
535	*Safety Information Exchange System for the Nogales Port of Entry*	85
544	*Service Strategies to Reduce Customer Time in MVD Field Offices*	87
547	*Arizona Statewide Safety Project Analysis Model*	89
550	*Automated Traffic Law Enforcement*	91
559	*Comprehensive Automated Driver's License Testing System: The Visual Acuity Test*	93
578	*ADOT Dyed Diesel Program*	95
579	*Improving PreDesign and Environmental Public Information*	97
580	*Barcode Inventory System*	99
582	*Multimodal Optimization of Urban Freeway Corridors*	101
583	*Open Source Software Study*	103
598	*Analysis of Bicycle Lanes (BL) Versus Wide Curb Lanes (WCL)*	105
599	*Transit Travel Study*	107
609	*Driver Education for Safety in Adverse Driving Conditions*	109

610	*Implementing a Statewide Rideshare Program in Arizona*	111

Structures

493	*Bridge Foundation Design Parameters, SGC Bearing Materials*	113
510	*Performance of Various Types of Bridge Deck Joints*	115
538	*High Performance Concrete for Bridge Structures in Arizona*	117
541	*Strategies and Retrofit Schemes for Concrete Bridge Decks in Arizona*	119
586	*Earth Pressure on Concrete Cantilever Retaining Wall*	121

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558	*High-Risk Crash Site Identification in Arizona*	123
571	*Options for Reducing ADOT's Legal Liability Costs*	125
591	*High Crash Risk Unsignalized Intersections*	127
592	*Building Tribal Traffic Safety Capacity*	129
593	*Development and Implementation of a Regional Safety Management Database*	131
611	*Combining Statistical and Judgmental (Descriptive) Information for Accident Pattern Analysis*	133

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594	*Flat-Tailed Horned Lizard Highway Crossing Study*	151
596	*Evaluation of Photo Radar for Freeway Enforcement*	153
597	*Highway Safety Incentive Report*	

Research Publications Catalog 155

Glossary of Acronyms

AASHTO	American Association Of State Highway & Transportation Officials
AC	Asphaltic Concrete
ACFC	Asphalt Concrete Friction Course
ACMS	Advanced Construction and Maintenance Systems
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
AHRRC	Arizona Hospitality Research and Resource Center
AHS	Automated Highway Systems
APL	Approved Products List
AR-AC	Asphalt-Rubber Asphalt Concrete
AR-ACFC	Asphalt-Rubber/Asphalt-Concrete Friction Course
ARS	Arizona Revised Statutes
ASU	Arizona State University
ATC	Automatic Traffic Counter
ATIS	Advanced Traveler Information System
ATRC	Arizona Transportation Research Center
BYU	Brigham Young University
Caltrans	California Department of Transportation
CCTV	Closed-Circuit TV
CIE	Commission Internationale de L'Eclairage
CRM	Crumb Rubber Modifier
CVISN	Commercial Vehicle Information Systems Network
DOT	Department Of Transportation
DPS	Department of Public Safety
ENTERPRISE	Evaluation of New Technologies for Roads Program Initiatives in Safety and Efficiency
FHWA	Federal Highway Administration
FM	Frequency modulation
FWD	Falling Weight Deflectometer
FY	Fiscal Year
G4	A type of guard rail
GCNP	Grand Canyon National Park
GIS	Geographic Information System
GOHS	Governor’s Office of Highway Safety
GPS	General Pavement Studies
GPS	Global Positioning Satellite
GTSAC	Governor’s Traffic Safety Advisory Council
HAR	Highway Advisory Radio
HCRS	Highway Condition Reporting System
HMA	Hot Mix Asphalt
HMAC	Hot Mix Asphaltic Concrete
HOV	High Occupancy Vehicle
HPC	High Performance Concrete

HPS	High-Pressure Sodium
IDMS	Integrated Document Management System
IES	Illuminating Engineering Society
ISPMMS	Integrated Sign and Pavement Marking Management System
ITD	Intermodal Transportation Division
ITEP	ITS, Traffic & Safety, Environment, Planning
ITG	Information Technology Group
ITS	Intelligent Transportation System
IV	Intelligent Vehicle
JLBC	Joint Legislative Budget Committee
JPA	Joint Project Agreement
LOS	Level Of Service
LPS	Low-Pressure Sodium
LTAP	Local Technical Assistance Program
LTPP	Long Term Pavement Performance
MAG	Maricopa Association of Governments
MH	Metal Halide
MOE	Measures Of Effectiveness
MP	Milepost
MSE	Mechanically-Stabilized Earth
MSM	Materials, Structures, and Maintenance
MUTCD	Manual of Uniform Traffic Control Devices
MVD	Motor Vehicle Division
N/A	Not Applicable
NAU	Northern Arizona University
NCAT	National Center for Asphalt Technology
NCHRP	National Cooperative Highway Research Program
NOAA	National Oceanographic and Atmospheric Administration
NTCIP	National Transportation Communications for Intelligent Transportation Systems Protocol
NTPEP	National Transportation Product Evaluation Program
OGFC	Open-Graded Friction Courses
P3	Pollution Prevention Plan
PC	Personal Computer
PIJ	Project Investment Justification
PM10	Particulate Matter less than 10 microns in diameter
PM2.5	Particulate Matter less than 2.5 microns in diameter
PMS	Pavement Management System
PRIDE	Product Resource Investment Deployment And Evaluation
R&D	Research & Development
R/W	Right-Of-Way
RFP	Request For Proposal
RV	Recreational Vehicle
RWIS	Roadway Weather Information System
SGC	Sand-Gravel-Cobbles
SHRP	Strategic Highway Research Program

SPR	State Planning & Research
SPS	Specific Pavement Studies
SPUI	Single-Point Urban Interchange
SR	State Route
TAC	Technical Advisory Committee
TBD	To be determined
TEA-21	Transportation Equity Act for the 21st Century
TI	Traffic Interchange
TNM	Traffic Noise Model
TPD	Transportation Planning Division
TRB	Transportation Research Board
TTI	Texas Transportation Institute
UDOT	Utah Department of Transportation
VMS	Variable Message Sign
VOC	Volatile Organic Compound
VSL	Variable Speed Limit
WASHTO	Western Association of State Highway & Transportation Officials
WIM	Weigh-In-Motion
WSDOT	Washington State Department of Transportation

Overview

The purpose of the Arizona Transportation Research Center (ATRC) is to provide a catalyst for the continuous process improvement of the Arizona Department of Transportation (ADOT). This responsibility includes the formal development of a focused research program as well as providing the forum for improvement through effective technology transfer, and fostering change in areas beyond the domain of research. To accomplish this ATRC uses the expertise of both public and private partners. This includes the University System of Arizona and the consultant community.

This ATRC annual report provides descriptions and progress updates for projects in the Fiscal Year (FY) 2006 *Estimated State Planning & Research (SPR) Program, Part II*. A total of 68 projects and 12 research support programs are included in this year's program: Fifty-two projects and 12 support programs have been carried over from prior-years' programs. There are 16 new projects (SPR numbers 596 through 611). Nineteen project reports were completed during Fiscal Year 2005. These are listed in the table below. SPR 571: *Options for Reducing ADOT's Legal Liability Costs* – was put back in the program. SPR 581: *Air Quality Effects of High Sound Walls in Urban Areas* has been cancelled. SPR 498: *Warranty Specifications* has been cancelled.

SPR#	**Completed Projects in FY '05**	**Manager**
473(5)	*ADOT Snowplow Research: On-Board Systems 2003-2004*	Owen
494	*Enhance the Pavement Management System*	Li
496	*Effective Control Measures at High Particulate Pollution Areas*	Kombe
512	*ITS Traffic Data Consolidation System*	Owen
530	*Critical Factors in the Development of Transit Systems in Rural Arizona*	Semmens
537	*Crash Data Collection and Analysis System*	Li
543	*Strategies to Integrate Environmental Stewardship into ADOT's Business*	Kombe
546	*Driver Education Impact on Safety*	Semmens
551	*Actual Speeds on the Roads Compared to the Posted Limits*	Semmens
553	*Driver License Manual Best Practices*	Semmens
556	*Right Turn Control Study: Yield Signs or Signals for Off-Ramps at Single-Point Urban Traffic Interchanges*	Li
559	*Comprehensive Automated Driver's License Testing System: The Visual Acuity Test (Phase 1: Pre-Pilot Test)*	Semmens
561	*Transportation Communications Phase 1: Needs Assessment*	Owen
562	*ITS Acceptance in the Elderly Community*	Owen
563	*Port Runners – Impact and Solutions*	Semmens
565	*Grand Canyon National Park Visitor Transportation Survey*	Semmens
567	*Remedies for Driver Error*	Semmens
568	*Arizona Highways Magazine's Impact on Tourism*	Semmens
570	*Rural ITS Progress Study – Arizona 2004*	Owen

Further information on these completed projects may be obtained from the project managers. Copies of the completed reports may be obtained from the ATRC Librarian. Telephone numbers and e-mail addresses for ATRC staff are shown below.

Overview

ATRC STAFF	PHONE NUMBERS	E-MAIL ADDRESSES
Manager		
Frank Darmiento	602-712-3134	fdarmiento@azdot.gov
Project Managers		
Christ Dimitroplos	602-712-7850	cdimotroplos@azdot.gov
Estomih (Tom) Kombe	602-712-3135	ekombe@azdot.gov
Yongqi Li	602-712-6927	yli@azdot.gov
Steve Owen	602-712-6910	sowen@azdot.gov
John Semmens	602-712-3137	jsemmens@azdot.gov
Librarian		
Dale Steele	602-712-3138	dsteele@azdot.gov
Technical and Administrative Support		
Carolyn Harmon	602-712-3130	charmon2@azdot.gov
Jeremy Sala – PRIDE Program Engineering Assistant	602-712-6430	jsala@azdot.gov
John Riemer – Field Data Technician	602-712-6348	jriemer@azdot.gov
Mihret (Mercy) Daniel – Library Technician		
FAX	602-712-3400	

Departmental Oversight of ATRC

The ADOT Research Steering Committee provides broad policy guidance to the research program. Its responsibilities include assuring adequate resources for research activities, allocating resources, and proposing specific projects, as necessary. The Steering Committee guides ADOT's research needs by identifying emphasis areas and overseeing the allocation of resources. When appropriate, the Steering Committee may also direct the implementation of research results.

The ADOT Research Council oversees the research effort. Responsibilities include advising the ATRC, setting research priorities, and approving funding for studies.

Steering Committee and Research Council members are shown in the following tables.

Overview

Research Steering Committee Members

Name	Group
John Bogert	Chief of Staff
Dale Buskirk	Director, Transportation Planning Division
Sam Elters	State Engineer
Robert Hollis	Federal Highway Administration
David Jankofsky	Deputy Director
Victor Mendez	ADOT Director
Stacey Stanton	Director-Motor Vehicle Division

Research Council

Name	Group
Julio Alvarado	Construction Group
Charles Bitner	Motor Vehicle Division
Dale Buskirk	Director, Transportation Planning Division
Frank Darmiento – chairman	Transportation Research Center
Jim Delton	State Materials Engineer
Jim Dickey	Director, Public Transportation Division
Doug Forstie	Deputy State Engineer
John Harper	Flagstaff District Engineer
Lonnie Hendrix	State Maintenance Engineer
Steve Jimenez	Valley Project Management
Karen King	Federal Highway Administration
Dan Lance	Deputy State Engineer
Sam Maroufkhani	Deputy State Engineer
Lisa Mattke	Information Technology Group
Jean Nehme	Bridge Group
Tom Parlante	Traffic Engineering Group
Rick Powers	Globe District Engineer
Mary Viparina	Assistant State Engineer
Shannon Wilhelmsen	Communication and Community Partnerships
Tim Wolfe	Transportation Technology Group

Financial and statistical data are presented in the *SPR Program Budgets* and *Program Statistics* sections. The amount of new funding for Fiscal Year 2006 is estimated at approximately $2,600,500. A total of about $4,808,823 is available in funds carried forward from prior programs.

The *Implementation* section briefly highlights Arizona Department of Transportation (ADOT) actions to implement research results.

The *Progress by Projects* section contains individual project reports for SPR projects in each of the following areas: Intelligent Transportation Systems (ITS), Traffic and Safety, Maintenance,

Overview

Materials and Construction, Planning and Administration, Environmental, and Structures. Information regarding other types of projects may be found in the *Research Support Programs*, *Pooled Fund Programs,* and *Experimental Projects* sections, respectively.

Also included in this Report is the *June 2005 Publications Catalog for the Arizona Transportation Research Center,* which lists all of the currently available research reports published by ATRC.

Budgets

The following tables summarize the financial status of each of the ongoing ATRC projects. Each project is identified by number and title. Funds carried over from previous years and funds to be provided by the Fiscal Year 2006 allocation are estimated for each project.

Each project is classified in one of the following categories: E: Environment, I: Intelligent Transportation Systems (ITS), M: Maintenance, MC: Materials and Construction, P: Planning and Administration, R: Research Support, ST: Structures, and T: Traffic and Safety.

State Planning & Research Funded Program

SPR#	***Project Title***	**Area**[1]	**Carry Over**[2]	**FY06 Funds**	Page
110	*ATRC Library Resources*	R	27,367	30,000	135
111	*Transportation Research Board Correlation/AASHTO*[3]	R	0	109,320	135
112	*Administration of Research*	R	128,936	30,000	135
113	*Support Staff Salaries*	R	40,615	210,000	136
114	*Technical Editing*	R	16,000	15,000	136
116	*PRIDE*	R	155,888	50,000	136
117	*Local Technology Assistance Program*	R	60,794	68,000	136
118	*Transportation Research Quick Study Program*	R	0	10,000	136
120	*Pooled Fund Studies*[3, 4]	R	0	50,000	138
124	*Research Traffic Data Collection*	R	164,130	100,000	137
125	*NCHRP*[3]	R	0	600,000	137
127	*Small Budget Studies*	R	31,000	100,000	137
371	*Maintenance Cost Effectiveness Study*	M	47,604		41
396	*LTPP and Other Test Section Management and Evaluation*	MC	47,618		54
402	*Development of Performance Related Specifications for Asphalt Pavements*	MC	24,646		55
459	*Environmentally Acceptable Cold Mix for Statewide Use*	M	114,302		43
460	*Evaluation of Cold In-Place Recycle Methods*	MC	36,056		57
471	*Specific Apps. of Shotcrete to Enhance Rock Mass Stability*	MC	9,222		60
473	*Arizona Intelligent Vehicle Research*	I	5,168		29
491	*Cost Benefit of Continued Pavement Preservation Strategies*	MC	28,264		62
493	*Bridge Foundation Design Parameters, SGC Bearing Materials*	ST	0		113
495	*A Field Study of Particulate Emissions*	E	5,312		1
500	*Aggregate Sources in Northern Arizona*	M	250,000		45
510	*Performance of Various Types of Bridge Deck Joints*	ST	17,960		115
518	*Reducing Development Cycle Time for Construction Process*	MC	27,671		64
520	*Maintenance Repair Procedures for Bridge Decks*	M	7,625		47
524	*Mix Design and Product Specifications for Asphalt Rubber Concrete*	MC	27,965		66
528	*Damage Done to Arizona Highways by Overweight Vehicles*	P	7,351		81
533	*Development of Materials for Repairing AR-ACFC Surfaces*	M	0		49
534	*Developing an Electronic "Signature" Process for ADOT.*	P	14,029		83

Budgets

SPR#	*Project Title*	Area[1]	Carry Over[2]	FY06 Funds	Page
535	*Safety Information Exchange System for the Nogales Port of Entry*	P	240,458		85
536	*Improved Snow Plow Headlight Visibility and Reduced Driver Fatigue*	M	50,000		51
538	*High Performance Concrete for Bridge Structures in Arizona*	ST	87,921	110,000	117
540	*Wildlife/Vehicle Collision Mitigation*[5]	E	44,560		4
541	*Strategies and Retrofit Schemes for Concrete Bridge Decks in Arizona*	ST	134,921		119
544	*Service Strategies to Reduce Customer Time in MVD Field Offices*	P	12,000		87
547	*Arizona Statewide Safety Project Analysis Model*	P	11,291		89
550	*Automated Traffic Law Enforcement*	P	2,280		91
555	*Atmospheric Effects on Highway Noise Propagation*	E	16,940		6
557	*Railroad & Highway Crossing Cooperative Signal Control*	I	18,953		31
558	*High-Risk Crash Site Identification in Arizona*	T	21,929		123
559	*Comprehensive Automated Driver's License Testing System: The Visual Acuity Test*	P	85,862		93
569	*Transportation Communications Interoperability Phase 2 – Resource Evaluation*	I	150,000		33
571	*Options for Reducing ADOT's Legal Liability Costs*	T	40,000		125
572	*Identification & Evaluation: Innovative Noise Barrier Designs*	E	50,000		9
574	*Use of NDT Equipment for Construction Quality Control of Hot Mix Asphalt Pavements*	MC	122,287		68
575	*Concrete Aggregate Durability Study*	MC	37,000		70
576	*US-93 Big Horn Sheep/Highway Collision Mitigation Study*	E	65,743		11
577	*Pavement Noise Study* [6]	MC	99,000		72
578	*ADOT Dyed Diesel Program*	P	11,666		95
579	*Improving PreDesign and Environmental Public Information*	P	15,000		97
580	*Barcode Inventory System*	P	11,031		99
582	*Multimodal Optimization of Urban Freeway Corridors*	P	14,326		101
583	*Open Source Software Study*	P	14,325		103
584	*Survey of Traffic Noise Reduction Products, Materials and Technology*	E	10,000		13
585	*Snowplow Simulator Training Evaluation*	I	100,000		35
586	*Investigation of Earth Pressure on Concrete Cantilever Retaining Wall for Variable Quality Backfill*	ST	150,000		121
587	*Evaluation of Salvage and Replanted Native Plants on ADOT Projects*	E	75,000		15
588	*A Study of the Effectiveness of Bighorn Sheep Underpasses on State Route 68*	E	175,000		17

Budgets

SPR#	*Project Title*	Area[1]	Carry Over[2]	FY06 Funds	Page
589	*Determination of 404 Permit Requirements and Habitat Restoration Requirements*	E	125,000		19
590	*Performance Related Pay Factors for Asphalt Concrete*	MC	50,000		74
591	*High Crash Risk Unsignalized Intersections*	T	50,000		127
592	*Building Tribal Traffic Safety Capacity*	T	110,000		129
593	*Development and Implementation of a Regional Safety Management Database*	T	100,340		131
595	*Real-time Adaptive Ramp Metering*	I	87,739		37
598	*Analysis of Bicycle Lanes (BL) Versus Wide Curb Lanes (WCL)*	P	15,000		105
599	*Transit Travel Study*	P	10,000		107
600	*Evaluating the Effectiveness of Microbe Application to Petroleum Spills at Crash Sites*	E	15,000		21
601	*Cost Evaluation of Cross-Border Truck Emissions Testing using Heavy Duty Remote Sensing (HDRS) Equipment*	E	15,000		23
602	*Sampling and Analyses of Storm Water Runoff*	E		40,000	25
603	*Continued Evaluation of Measures to Minimize Wildlife-Vehicle Collisions & Maintain Wildlife*	E		166,313	27
604	*Real-Time Adaptive Ramp Metering: Phase 2– Implementation and Enhancement*	I		200,000	39
605	*Investigations of Environmental Effects on Freeway Acoustics*	MC		90,000	76
606	*Implementation Of The Mechanistic-Empirical (M-E) Design Guide For Arizona*	MC		350,000	78
607	*Analysis Of And Recommendations For Alleviating Roadway Surface Damage Caused By Snowplow Activity.*	M		20,000	53
608	*Development of Rational Pay Factors Based on Concrete Compressive Strength Data*	MC	14,000	0	79
609	*Driver Education for Safety in Adverse Driving Conditions*	P		50,000	109
610	*Implementing a Statewide Rideshare Program in Arizona*	P		50,000	111
611	*Combining Statistical and Judgmental (Descriptive) Information for Accident Pattern Analysis*	T		60,000	133
999	*Special Projects/Contingency*	--	603,583	91,867	137
	Closed Projects[7]	--	436,915		
	TOTALS		4,808,823	2,600,500	

Budgets

Table Notes:

[1] Abbreviations under Area refer to program areas – E: Environment, I: Intelligent Transportation Systems (ITS), M: Maintenance, MC: Materials and Construction, P: Planning and Administration, R: Research Support, ST: Structures, T: Traffic and Safety

[2] Includes amounts newly transferred into projects from earlier program years' contingency funds. All carryover amounts for these and other projects are as of 07/01/05.

[3] Funded with 100% Federal funds.

[4] **FY2006** funding includes a set aside of $25,000 for new pooled fund projects and $25,000 for project SPR-3(020), *IVHS Study (ENTERPRISE)*. The following pooled fund amounts were obligated using carryover funds from SPR-999: $50,000 – project SPR-3(020), *IVHS Study (ENTERPRISE)*; $50,000 – project TPF-5(004), *Long Term Pavement Performance (LTPP) Specific Pavements Study (SPS) Traffic Data Collection*; $5,000 – project TPF-5(036), *Transportation Asset Management Research Program*; $105,055 – project TPF-5(037), *Southeast Superpave Center*; and $25,000 – project TPF-5(085), *Transportation Security Plan*.

[5] SPR-540 includes a balance of $19,954 from SPR Part 1 funds P600013P, TP10 (original Part 1 budget $113,000) that is not shown in the table.

[6] Funded in FY2004 with $364,000 in SPR Planning funds and $99,000 in FY2005 Research Funds. Future years will be funded with Research funds as follows: FY2008 - $97,000; FY2010 - $97,000.

[7] Funds from completed projects (includes SPR-123, 439, 451, 479, 483, 494, 496, 512, 530, 532, 537, 539, 542, 545, 546, 553, 556, 560, 561, 562, 563, 564, 567, 568, 581, 594). These funds will be transferred to other research activities.

Alternatively Funded Projects

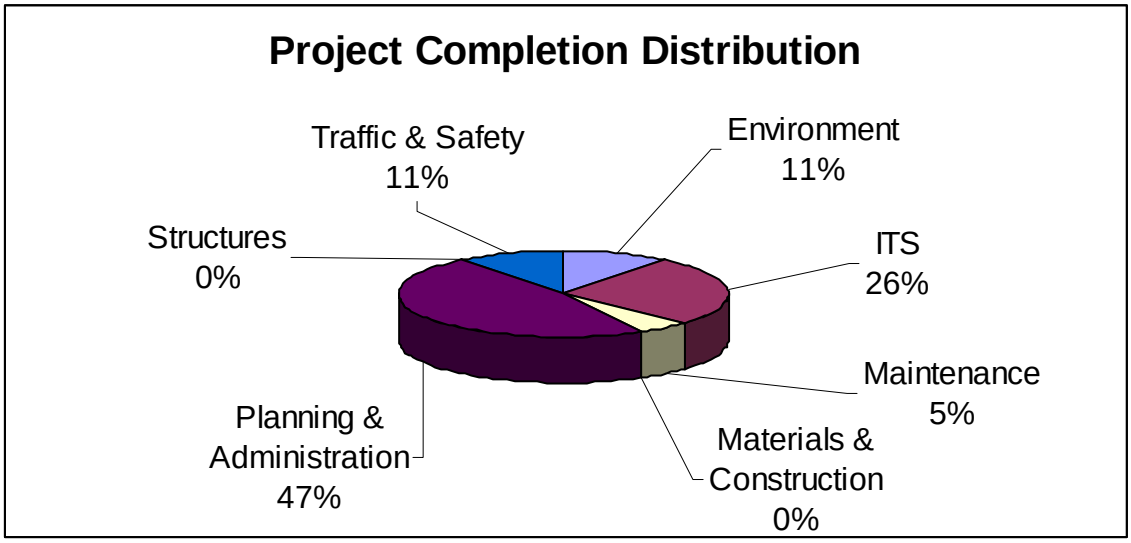
ID#	Project Title	*Area*	Amount	*Page*
AZ-594	*Flat-Tailed Horned Lizard Highway Crossing Study*	E	118,400	151
AZ-596	*Evaluation of Photo Radar for Freeway Enforcement*	I	36,570	153
SPR-597	*Highway Safety Incentive Report*[1]	T	13,320	155

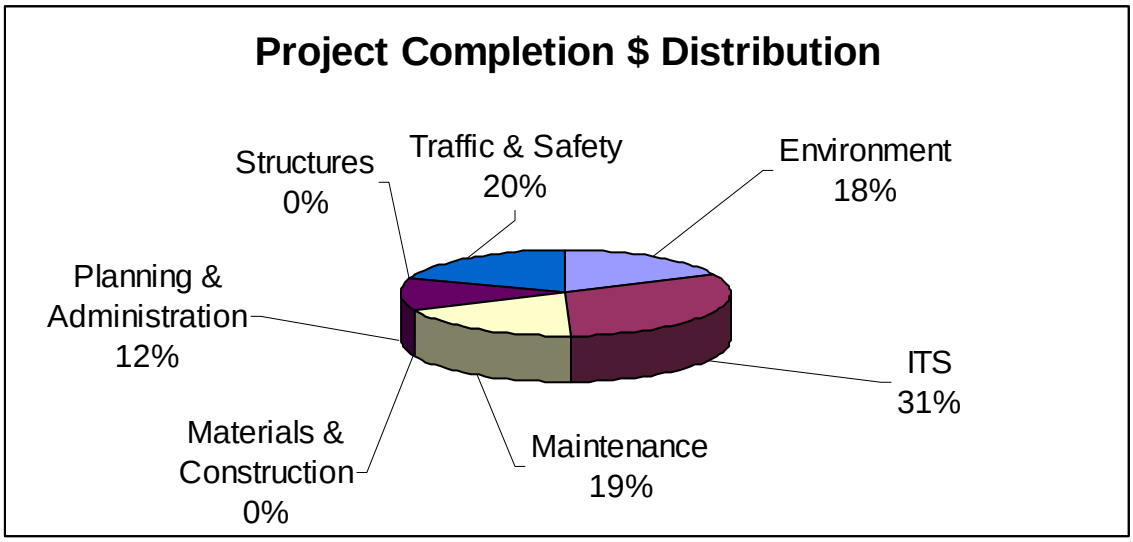
[1] Funded by a $15,000 grant from the Arizona Governor's Office of Highway Safety

Statistics

There were 19 project completions accounting for a budget of $1,133,000 during FY 2005 (July 1, 2004 through June 30, 2005). The distribution of these projects by emphasis area is shown below.

Category	Number of Projects	Budget
Environment	2	$ 200,000
ITS	5	$ 359,000
Maintenance	1	$ 215,000
Materials & Construction	0	$ 0
Planning & Administration	9	$ 134,000
Structures	0	$ 0
Traffic & Safety	2	$ 225,000
Totals	19	$ 1,133,000

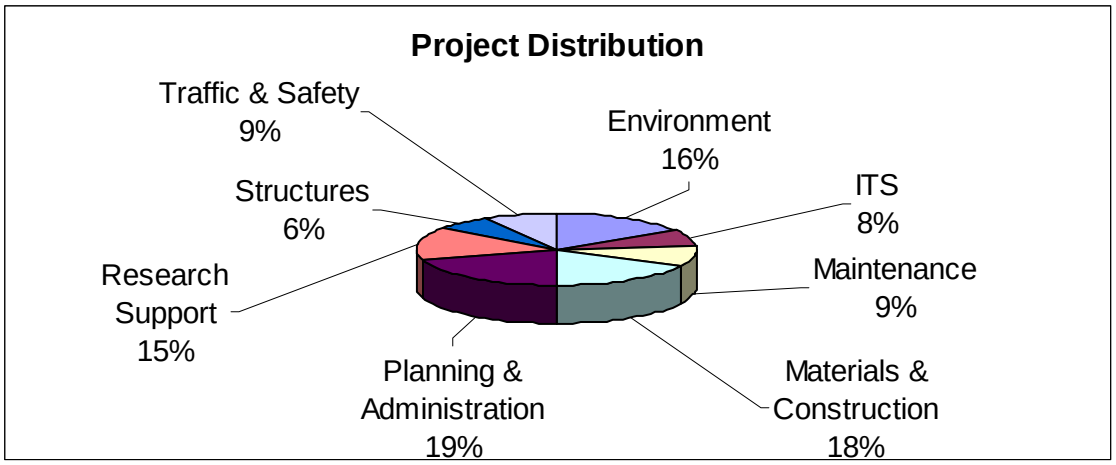


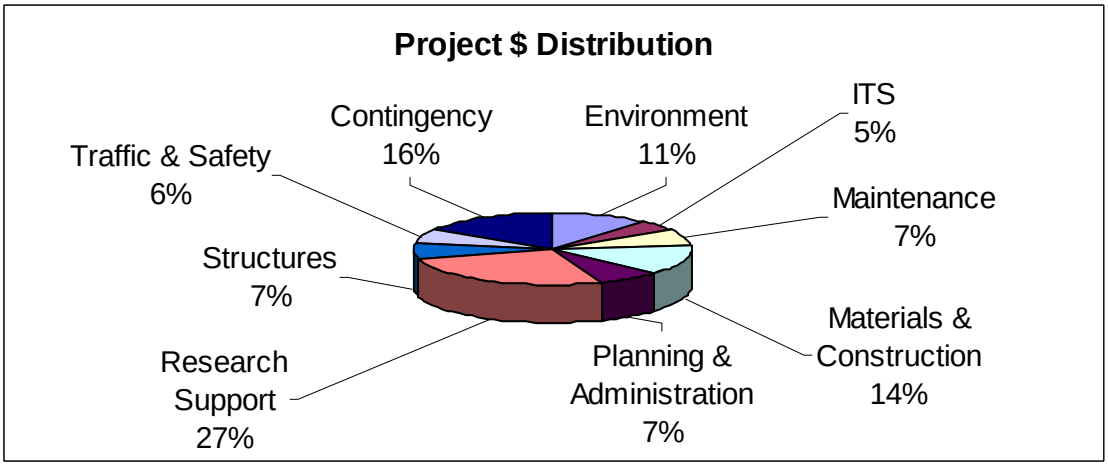


Statistics

There are 80 projects in the current program accounting for a budget of $7,011,323. The distribution of these projects by category is shown below.

Category	Number of Projects	Budget
Environment	13	$ 803,868
ITS	6	$ 361,860
Maintenance	7	$ 469,531
Materials & Construction	14	$ 963,729
Planning & Administration	16	$ 514,619
Research Support	12	$ 1,869,050
Structures	5	$ 500,802
Traffic & Safety	7	$ 395,499
Contingency	0	$ 1,132,365
Totals	80	$ 7,011,323





Implementation

The following list highlights implementation activities undertaken during Fiscal Year 2005:

SPR# **Project**

473 *Arizona Intelligent Vehicle Research:* 2004-05 was the third winter for the project's four snowplows with collision warning radar, and three with infrared night vision. The plows carried out maintenance operations in the heaviest winter conditions since deployment in February 2003. ATRC monitored performance and offered system support to the fleet, although very few repairs were needed this snow season. An internal report was prepared, summarizing the results of the past winter season. The testing, on seven plow routes in northern Arizona, reinforced the advantages and limitations noted earlier for each low-cost commercial driver-warning system. As a result, wider use of collision warning radar is being considered for snowplows and other ADOT fleet units, and the project may also introduce and evaluate rear and blind-spot warning systems. However, further consideration of night vision for snowplow trucks would require significant design refinements by the manufacturer.

511 *Best Practices in Project Management:* Statewide and Valley Project Management requested Scheduling Section to monitor scope changes coming to PRB. S&VPMG reported on these statistics at the most recent Dev. Ops Partnering meeting in June 2004. Dev/Ops Partnership directed S&VPMG to develop more information regarding scope changes. SPMG has developed processes for monitoring and managing project budget changes. The Dev/Ops Quality Team is working with S&VPMG on developing Quality improvement processes for project management. S&VPMG with the Dev/Ops Quality Team is working on developing Quality improvement processes for project management. The objective is to document the processes for each project management deliverable. S&VPMG are working with Finance and other ADOT orgs/functions to improve business processes and to provide PM's with reports and information that will enable them to perform their responsibilities and to be able to be accountable. SPMG is working with other technical functions to document their work tasks as sub-sets to standard activities and to correlate with project deliverables. SPMG has developed processes for monitoring and managing project budget changes. These processes are being implemented. SPMG is working with Environmental and Enhancement Group and with Construction Group on processes to evaluate labor requirements and establish work standards. The S&VPMG process improvement efforts will be supported by the continuing training of project managers and team members.

512 *ITS Traffic Data Consolidation System:* The primary goal to consolidate roadway data sources was implemented in phases, coinciding with scheduled upgrades to the web-based HCRS system already in use statewide. Additional information, resource links, and "user-friendly" aspects for ADOT operators were successfully developed. This project has provided valuable new tools for both field and central operational management of the highway system by and among the Districts, and the Traffic Operations Center. It has further provided the public with better delivery of critical rural and urban travel conditions information.

Implementation

526 *Coordination of Commercial Vehicle Data Collected by Automatic Traffic Counter (ATC) and Weigh-In-Motion (WIM):* Long-range planning will ensure commercial vehicle data collection and dissemination is a priority across ADOT departments. An intra-agency task force that includes representatives from each of the stakeholder groups will be used to re-think current practices. Policies and procedures will be established so as to address the requirements of each department as well as meet ADOT's federal and state data reporting commitments. Consistent standards of practice relative to data collection, storage, and exchange will be established. Data partnerships will be formed in an effort to achieve cost savings and resource conservation. Repair and/or replacement of non-functional traffic recorders and installation of additional weigh-in-motion devices are being evaluated.

527 *Measurement Tools for Assessing Motor Vehicle Division Port-of-Entry Performance:* Hourly stats are maintained for daily report documents (existing process at local level). Hard numbers are reported monthly, converted to % values as needed to view the operation from various perspectives. Changes in program activity compared to WIM measurements covering a longer-term period in order to model the overall impact of enforcement. Mobile operations focus on specific corridors.

546 *What is the Effect of Driver Education Programs on Traffic Crash and Violation Rates?* MVD declined to pursue the recommended changes in legislation.

548 *Uninsured and underinsured drivers:* MVD declined to pursue the recommended changes in legislation.

549 *Options for Improving Compliance with Vehicle Registration Laws:* MVD has requested a follow-up project to develop a data sharing prototype process with electric utility companies as a means of enforcing compliance.

551 *Actual Speeds on the Roads Compared to the Posted Limits:* Speed limits are periodically review by District and Traffic to determine the appropriate speed limit per policy that includes traffic conditions and roadway conditions.

552 *Options for Improving HOV Lane Enforcement:* DPS is working with ADOT to create wide medians areas next to the HOV lanes to conduct enforcement action. This requires statutory change. Current law requires motorists to move right and stop. DPS is working on a plan for periodic special HOV lane enforcement details. New technology is being monitored as it emerges and ADOT & DPS will consider implementing it if it appears feasible and warranted.

561 *Transportation Communications Interoperability Phase 1 – Needs Evaluation:* This ITS project identified goals, resources and shortcomings for effective radio interoperability in remote rural conditions across Arizona. It defined several key pilot projects to improve ADOT's internal radio communications, three of which have already been implemented by TAC members. Two additional pilot projects for better ADOT-DPS communications are programmed in the new project SPR 569, being initiated in July 2005.

Implementation

562 *ITS Program Acceptance in the Elderly Community:* This research has helped ADOT to improve the overall efficiency of the highways and freeway system for the growing number of older drivers. The study developed information that is relevant for all levels – federal, state and local – on issues of ITS acceptance by the elderly population. ADOT's Transportation Technology Group incorporated the findings into the state's ITS traveler information resources and field operational activities.

563 *Port Runners – Impact and Solutions:* MVD has discussed partnering with DPS and the Sheriff's Office to assist in apprehending port runners. Few details have already taken place and as resources become available future joint agency details will be planned. Addition funding has been received to increase staffing at a select number of our interstate ports. These added personnel will participate in these activities. A select number of ports are currently in the process of redesign and consideration to queue lengths are included.

565 *Grand Canyon National Park Visitor Transportation Survey:* PTD will work with TPD, park officials, railroads and bus companies to ensure that public transportation options are adequate. TPD will coordinate with ITD to address possible improvements to State Highways serving the Grand Canyon during planning activities. TPD will coordinate with ITD to address improved signage along ADOT ROW during planning activities.

567 *Remedies for Driver Error:* Communication and Community Partnerships is planning public information campaigns on yielding and work zone safety. Previously we have conducted public information campaigns on highway striping and signage and rumble strips. We recommend the Governor's Office of Highway Safety as the appropriate office to consider the possible implementation of a multi-agency public awareness campaign, which may require collaboration with the private sector for sponsorship and funding.

568 *Arizona Highways Magazine's Impact on Tourism:* The magazine's economic impact as validated in this research will be a major peg in the promotional planning in support of the magazine's 80th anniversary activities and events in 2005. Further, a summarized version of the data will be included in "slug line" copy on all press releases for at least the next three years. Finally, a separate promotional campaign will be launched to underscore the economic importance of the magazine to the rural areas of the state that are unable to afford their own promotional efforts.

570 *Rural ITS Progress Study – Arizona 2004:* ADOT has gained significant value from this study, by validating the investment in current rural ITS systems, and by identifying potential future improvements. This research delivered performance assessments of each critical system, and overall ITS benefits to highway operations for both the Technology Group and individual Districts. Efforts have begun within ADOT to enhance the effectiveness of some current systems. Alternate approaches are under review for certain others, such as RWIS weather information resources.

580 *Barcode Inventory System:* A pilot test was designed, equipment and labels were purchased and two test sites were selected.

Environment

Project 495, FY 2000

A Field Study of Particulate Emissions from Major Roadways in the Phoenix Airshed

Research Agency:	Arizona State University	Program Date:	07/01/99
Principal Investigator(s):	Dr. Jim Anderson	Contract Date:	11/17/99
Contract Amount:	$321,000	Original Completion Date:	5/17/01
Program Budget:	$321,000	Estimated Completion Date:	10/31/04
Expenditures to date:	$315,688	Is project on schedule?	No
Available Amount:	$5,312	Advantage No.:	R049512P
Percent complete		Responsible ATRC Staff:	
Through 6/30/05	95%	(Project Manager)	Tom Kombe

PROBLEM STATEMENT

The new U.S. Environmental Protection Agency standard for particulate matter focuses on the size range of particles that are easily respired and retained within human lungs, 0.1 to 2.5 microns in diameter (PM2.5). Our current knowledge of particle emissions from transportation-related sources is based primarily on the existing PM10 standard, a measure of the mass of particles smaller than 10 microns. PM10 is dominated by the larger particles, so that current understanding of the contributions of transportation-related sources to PM10 is not applicable to PM2.5. Future transportation models that predict ambient particle concentrations will have to incorporate the PM2.5 standard. Because large variations in emission factors occur because of variables like climate, roadway type, and vehicle type and conditions, generic emission factors from other regions or laboratory studies will not suffice. Accurate modeling of the Phoenix urban area requires direct measurement of particulates, their compositions, size distributions, and concentrations and accompanying meteorological conditions in three dimensions along and away from the linear sources that major roadways represent. Measurements of particulates must be accompanied by accurate counts of vehicle numbers, types, and their speeds.

A significant challenge in a field study of roadway emissions is separation of the urban regional plume from the freeway emissions. A second challenge in an area of complex terrain like Phoenix and Tucson is that the concentration of particles in the urban plume and the dispersion of roadway pollutants are both dependent upon position within topographically controlled wind fields. The experimental design must address these problems.

There is a serious disparity between receptor-model and emission-inventory estimates of the contribution that combustion sources make to fine particulates. For the Phoenix area, receptor models estimate that 70% of primary fine particulates come from combustion. In contrast, emission inventories estimate that 18% come from combustion. Part of the disparity is due to an underestimation of PM2.5 from vehicular exhaust coupled with possible overestimates of re-entrained dust. More of the disparity may stem from a lack of knowledge of the composition of re-entrained dust, which may consist of aggregates of soil particles with carbonaceous material rather than just soil particles alone. A field study combined with numerical modeling is the best way to answer this question. The accurate evaluation of any fine particulate control strategies cannot proceed without our knowledge of the different contributing particle fractions.

ANTICIPATED BENEFITS

The proposed study will provide data about transportation-related particulates that are essential for future transportation modeling due to (1) the serious non-attainment status of the Phoenix airshed, (2) the continuing growth in traffic caused by growing population, and (3) the eventual enforcement of the PM2.5 standard. The work on emission factors for re-entrained mineral dust will be the first such study to use quantitative single-particle analysis methods. The aircraft study will provide data about the 3-dimension variation in aerosols and associated meteorological conditions, essential for accurate fine-scale modeling of linear roadway sources. It will provide optical data that are linked to data about the aerosol's chemical and physical properties, essential for modeling of visibility impairment. The combination of rapid population growth in Maricopa County, current and planned future freeway construction, and the non-attainment status of the area with regard to federal standards make it imperative that we gain a better understanding of transportation-related particulates and of their dispersion and transport in our desert, complex terrain region. Delay in examining these issues will only make it more difficult to address these issues.

RESEARCH OBJECTIVES

- To determine the contribution of vehicle-related emissions on major roadways to PM2.5 and PM10 in the Phoenix airshed;
- For vehicle-related emissions to determine the relationships between particle properties such as individual-particle and bulk composition, size, and optical properties;
- To determine emissions factors for re-entrainment of mineral dust particles from major roadways, arterials and freeways including data by vehicle type and speed;
- To determine whether re-entrained mineral dust is aggregated with significant amounts of carbonaceous material;
- To improve numerical modeling of fine particulate dispersion modeling
- To make progress on the resolution of the disparity between receptor models and emissions inventories of fine particulates for the Phoenix airshed.
- Evaluate existing literature and estimate particulate deposition rates

At a minimum, the following tasks will be accomplished:

1. Sample and analyze particulates using ground-based individual-particle and standard PM2.5 and PM10 mass samplers on freeway medians and arterials at either existing Arizona Department of Transportation (ADOT) traffic-counting locations or co-located with special counters. Quantitative single-particle analysis of inorganic particles by automated scanning electron microscope should cover the size range of 0.1 to 10 microns, from which the equivalent of both PM2.5 and PM10 can be extracted.
2. Measure the temperature, relative humidity, and wind speed (down to 0.5 m/s) at the freeway median sites for use in modeling. Measure the average fine particle concentrations.
3. Make measurements both upwind and downwind of such segments in order to separate the contribution of background emissions from roadway emissions. Both single-particle and mass aerosol samplers should be used. The aerosol optical properties and meteorological conditions should be measured.

4. Numerically model the deposition of vehicle-related fine particulates.
5. Determine the mass emission rates and relative contributions of combustion particles, other vehicle-related particles such as from tires, and re-entrained mineral dust to primary fine particulates emitted from major roadways in the airshed.

EXPECTED IMPLEMENTATION

The proposed research will be of direct relevance to the Environmental Planning Section of ADOT and falls within the areas of responsibility of Air Quality personnel. The work will also be coordinated with the Air Quality Division of the Arizona Department of Environmental Quality (ADEQ).

STATUS OF THE RESEARCH

The project is completed except for final report submission. All field experimentation and analysis was done. The draft final report review was completed early 2004. The research team has not delivered on promises to submit a final report document for publication. The ATRC Manager is following up the matter with ASU.

TECHNICAL ADVISORY COMMITTEE (TAC)

Fred Garcia	Environmental Planning, ADOT
Beverly Chenausky	Transportation Planning, ADOT
Ruey-in Chiou	Maricopa Association of Governments
Peter Hyde	ADEQ, Air Quality Assessment.
Gaye Knight	City of Phoenix, Office of Environmental Programs
Jo Crumbaker	Maricopa County, Environmental Services
Ed Stillings	Federal Highway Administration
Tom Kombe	ADOT Research Project Manager, ATRC

Project 540, FY 2002 / FY2004

Evaluation of Measures to Minimize Wildlife Vehicle Collisions and Maintain Wildlife Permeability across Highways (Phase1 and Phase II)

Research Agency:	Arizona Game & Fish Dept.	Program Date:	10/01/2001 & 10/1/2003
Principal Investigator(s):	Mr. Norris Dodd	Contract Date:	01-29-2002 & 12/16/2003
	Phase 1 /Phase 2		
Contract Amount:	$217,000/ $344,000	Original Completion Date:	12/04 & 06/06
Program Budget:	$217,000/ $344,000	Estimated Completion Date:	12/04 & 06/06
Expenditures to date:	$217,000/ $279,486	Is project on schedule?	Yes
Available Amount:	$0 / $64,514*	Advantage No.:	R054014P, others
Percent complete through 6/30/05	100% / 70%	Responsible ATRC Staff: (Project Manager)	Tom Kombe

*includes $19,954 SPR Part 1 funds

PROBLEM STATEMENT

Animal/vehicle collisions result in human fatalities, injuries, and extensive property losses every year in Arizona. As the Arizona Department of Transportation (ADOT) upgrades existing rural highways the problem intensifies. Collisions increase with speed and traffic volume. The issue of vehicle/wildlife collisions is becoming more of a concern to citizens and resource managers. These collisions cause millions of dollars of property damage and litigation associated with such collisions is increasing. These concerns are impacting highway construction costs and project schedules as highway designers and scientists look for solutions to the problem. A lack of scientifically collected data on the effectiveness of various mitigation measures compounds the problem especially here in Arizona where no valid studies have been conducted.

ADOT will be implementing a comprehensive package of measures to address wildlife concerns as part of the upgrade of SR260 from Payson to Show Low. These measures will conservatively cost more than 3.5 million dollars. None of these measures have been implemented in Arizona before nor has their effectiveness been evaluated. Since animal/vehicle collision mitigation methods will be used in the future on other highways in Arizona, it is imperative that these methods are evaluated to determine their effectiveness at increasing highway safety and maintaining wildlife permeability.

RESEARCH OBJECTIVES

The objective of this proposed research is to measure the effectiveness of the various highway design features to reduce wildlife/vehicle collisions and maintain habitat connectivity on the state highway 260 corridor.

ACTION PLAN - TASKS

At a minimum, the following tasks will be accomplished by the researcher:

1. Meet with the Technical Advisory Committee to discuss the scope of work and action plan.

2. Document and report the incidence of wildlife/vehicle collisions along the entire length of the study area. Analyze and compare the wildlife/vehicle collisions along the test area with the data in the same areas collected since 1987.
3. Monitor the movement of adult elk in three time periods; pre-construction, during construction, and post construction. Analyze the data to determine the degree to which wildlife permeability across the highway is maintained.
4. Monitor the wildlife-proof fencing to determine its effectiveness at limiting wildlife access to the fenced highway.
5. Document the research effort and findings in a final report.

EXPECTED IMPLEMENTATION

This research will provide the required data for the need, design, location, and frequency of underpasses for the conveyance of wildlife under a highway. It will evaluate the effectiveness of various wildlife-proof fence configurations in containing and directing large game animals. The research will evaluate the effectiveness of one-way gates and escape ramps in allowing large game animals to return to the off-highway side should a breach in the fence occur. This research will establish a database that will provide more complete information on the frequency, location, species, and damage related to wildlife/vehicle collisions

STATUS OF THE RESEARCH

Phase I of the project is completed. An interim Phase I report was submitted for internal use. Phase II of the project is currently ongoing, with good progress.

TECHNICAL ADVISORY COMMITTEE (TAC)

Bruce Eilerts	Natural Resources, ADOT
Mike Ross	Tonto National Forest
Earl (Duke) Klein	Tonto National Forest
Doug Brown	AZ Dept. of Administration
Norris Dodd	AZ Game & Fish Dept., Research Leader
Ray Schweinsburg	AZ Game & Fish Dept.
Steve Thomas	Federal Highway Administration
Terry Brennan	Tonto National Forest
Melissa Maiefski	ADOT Environmental & Enhancement Group
Tom Kombe	ADOT Research Project Manager, ATRC
Cindy Eiserman	Risk Management, ADOT

Project 555 FY 2003

Determination of Atmospheric Effects on Highway Noise Propagation

Research Agency:	ATS Consulting, LLC	Program Date:	10/01/2002
Principal Investigator(s):	Dr. Hugh Saurenman	Contract Date:	07/01/2003
Contract Amount:	$170,000	Original Completion Date:	06/30/2005
Program Budget:	$170,000	Estimated Completion Date:	12/31/2005
Expenditures to date:	$153,060	Is project on schedule?	Yes
Available Amount:	$16,940	Advantage No.:	R055515P
Percent complete through 6/30/05	95%	Responsible ATRC Staff: (Project Manager)	Tom Kombe

PROBLEM STATEMENT

Long-term exposure to noise is a function of atmospheric conditions that current highway prediction methods ignore by assuming a neutral, homogeneous atmosphere. Prevailing atmospheric conditions can cause receivers beyond those adjacent to a highway to be exposed to highway noise otherwise considered inaudible using standard prediction methods. This effect may not only increase audibility of highway noise but can produce noise levels that exceed the applicable noise impact criteria.

Noise emanates directly from primary noise sources such as exhausts and encased engines and from tires where the noise emissions depend upon the pavement type. Secondary noise sources arise due to reflections from pavement and vertical surfaces such as highway noise barriers. Noise barriers reflect sound energy from an elevated location and spread the highway noise over a wider area. Absorptive sound barriers offset this effect.

Negative public attitudes towards noise barriers can result from this increased noise. As an example, Ohio DOT temporarily suspended its Type II program five years ago in response to strong public criticism that arose from people whose properties were not adjacent to the highway but reported being able to hear it more clearly after walls were installed. People next to the highway still benefited from reduced noise, but more distant locations were exposed to greater highway noise.

Refraction is the underlying phenomenon that correlates with these observed (i.e. perceptible and measurable) increases or decreases of noise exposure. The refraction causes sound to follow a curved trajectory as it propagates away from the highway. As such, the effects are more noticeable at greater distances from the sound source.

The refracted sound path is fundamentally influenced by the effective sound speed as a function of height above the ground surface since sound refracts towards areas with lesser effective sound speeds. When the effective sound speed increases as a function of height, as is the case for downwind and temperature inversion conditions, sound will refract downwards. When the effective sound speed decreases as a function of height, as is the case for upwind and temperature lapse conditions, sound will refract upwards.

Over flat, grassy ground the effects of downward refraction can increase noise levels by about 0.5 dB(A) (over asphalt by about 2 dB(A)). However, when sound propagating near ground level is blocked by intervening obstacles, the introduction of refracted sound can increase noise levels by 30 dB(A). Since a 10 dB(A) change in sound levels is typically assumed to be a factor

of two in changed perceived loudness, a 30 dB(A) change can be extrapolated to represent an eight-fold increase in perceived noise levels. This can negate the benefit provided to many receivers otherwise shielded from the highway.

RESEARCH OBJECTIVES

The objective of the proposed research project is to quantify the typical non-neutral effect of refraction on highway noise, and the range of this effect, and investigate a method to screen for noise impacts.

At a minimum the following tasks will be accomplished:

1. Review of literature and available data
2. Study differences between actual and neutral-atmospheric conditions
3. Assess the necessity for project specific monitoring and the utility of pre-existing regional data, such as wind roses
4. Implement prediction algorithm
5. Evaluate expected seasonal and diurnal patterns
6. Conduct two-week field measurement program during critical time periods
7. Correlate noise level variability with atmospheric parameters that control the effective sound speed profile
8. Investigate utility of a screening level design tool to identify potential noise impacts due to prevailing non-neutral atmospheric conditions
9. Document all project activity and recommendations in a Final Report.

EXPECTED IMPLEMENTATION

The Transportation Research Board (TRB) — Section A1F04 on Noise has suggested that atmospheric effects remain the largest source of prediction error when the new Traffic Noise Model (TNM) predictions are compared to field measurements. R&D is required to estimate the effect of refraction on noise propagation for more typical, non-neutral atmospheric conditions. This R&D will assist ADOT in anticipating and addressing citizen concerns and allow for a better understanding of when and where increased audibility and noise impacts are, or are not, to be expected.

The preliminary screening for noise impacts due to atmospheric effects beyond first row residences will allow for greater opportunity to address citizen concerns in advance and consider the merits of additional noise mitigation, such as low-noise pavements and absorptive noise barriers. This will help increase public acceptance of highway projects.

Additional benefits to ADOT include more accurate prediction of the extent of potential noise impacts of new facilities on distant receivers, ability to study the spreading of sound by vertical surfaces such as noise barriers, and the prediction of the degradation of noise barrier performance by refracted noise.

STATUS OF RESEARCH

A draft final report was submitted, reviewed by the TAC, and a revised final report completed. The report is currently awaiting FHWA publication approval upon their review. Report publication is expected during the coming quarter.

Environment

TECHNICAL ADVISORY COMMITTEE

Fred Garcia	Environmental & Enhancement Group
Steve Thomas	Federal Highway Administration
Kelly McMullen	Maricopa County Department of Transportation
Robert Pikora	City of Phoenix
Jerri Horst	S. R. Beard & Associates
Tom Kombe	ADOT Research Project Manager, ATRC

Environment

Project 572 FY 2004

Identification and Evaluation of Innovative Noise Barrier Designs

Research Agency:	HDR, Inc.	Program Date:	10/01/2003
Principal Investigator(s):	Mr. Dustin Watson	Contract Date:	04/07/05
Contract Amount:	$50,000	Original Completion Date:	06/30/06
Program Budget:	$50,000	Estimated Completion Date:	06/30/06
Expenditures to date:	0	Is project on schedule?	Yes
Available Amount:	$50,000	Advantage No.:	R057216P
Percent complete through 6/30/05	15%	Responsible ATRC Staff: (Project Manager)	Tom Kombe

PROBLEM STATEMENT

The typical strategy to reduce traffic noise near highways is the construction of concrete walls, masonry block walls, or earthen berms. These mitigation strategies are very effective for noise reduction, but sometimes result in undesired impacts, such as blocked views and large shadows across residents' yards. Also, when there is a need to increase the noise reduction of existing noise walls, the standard approach is to add height to the existing wall or, many times, replace the entire wall with a new higher wall. These retrofitting approaches can be very costly.

Innovative noise barrier designs and treatments have been successfully utilized in other states and throughout Europe for a number of years that allow the initial construction of a noise wall to be lower in height than a traditional wall. Also, retrofitting an existing wall with an innovative top treatment will reduce noise levels and eliminate the need for costly wall height increases or wall replacement. Such top treatments include angled tops, irregular top edge, T-top treatments, and other applications.

RESEARCH OBJECTIVES

The primary objective of the research is the determination of whether innovative noise barrier designs could be effectively utilized: (1) to reduce overall wall height and cost during initial construction, and (2) to substitute for costly retrofit wall height increases or wall replacement.

The research effort will begin with an exhaustive literature search of the various innovative noise barrier designs and treatments that have been used in other states and in other countries. The search will focus on designs for both initial construction and retrofit construction. The project will evaluate the economic, acoustical, and aesthetic feasibility of the innovative noise barrier designs for possible application in Arizona. An evaluation matrix will be developed to assist in this analysis.

It is anticipated that several strategies will be identified that could be effectively used in the ADOT noise abatement program. These innovative strategies will provide a cost-effective noise reduction, while reducing the aesthetic, visual, shadows, and other impacts typically associated with higher noise walls. Substantial cost savings are likely with the identification of innovative applications and top treatments that could reduce noise levels without costly retrofit wall height increases or complete wall replacement. A quantification of these costs will be part of the evaluation effort

Environment

EXPECTED IMPLEMENTATION

This research effort will identify feasible innovative applications and top treatments for noise barriers that could cost-effectively reduce noise levels without undesired impacts. The ultimate implementation would be the use of these techniques where appropriate and beneficial.

STATUS OF RESEARCH

Project work is ongoing.

TECHNICAL ADVISORY COMMITTEE

Mike Dennis	ADOT Environmental & Enhancement Group, Project Champion.
Fred Garcia	ADOT Environmental & Enhancement Group
Laura Tsosie	ADOT Environmental & Enhancement Group
Steve Thomas	Federal Highway Administration
David Pekara -	VSI
Angela Newton –	Noise & Air Solutions
Tom Kombe	ADOT Research Project Manager, ATRC

Project 576, FY 2004

US-93 Big Horn Sheep Study

Research Agency:	AZ G&F Department	Program Date:	10/01/2003
Principal Investigator(s):	Jim DeVos & Ted McKinney	Contract Date:	02/26/2004
Contract Amount:	$185,000	Original Completion Date:	08/31/2006
Program Budget:	$185,000	Estimated Completion Date:	08/31/2006
Expenditures to date:	$119,257	Is project on schedule?	Yes
Available Amount:	$64,743	TRACS No.:	R057615P
Percent complete Through 6/30/05	60%	Responsible ATRC Staff: (Project Manager)	Tom Kombe

PROBLEM STATEMENT

Big horn sheep occur in the area of the proposed Highway 93 upgrade and the potential exists that this population will be adversely impacted by highway upgrades. Previous studies by researchers have documented the movement of bighorn sheep across the existing Highway 93 alignment; these investigations have noted the occurrence of multiple collisions between sheep and automobiles during the years of the studies. As traffic volumes increase and the actual roadway increases in size from 2 lanes to 4 lanes, there is increased likelihood that highways may isolate resident populations of Ovis canadensis into small, disjointed herd units.

RESEARCH OBJECTIVES

1. Identify the patterns of movement of Big Horn Sheep along this corridor.
2. Recommend measures to minimize adverse impacts during the US-93 project's construction phase.

This is the initial phase of a potentially multi-phase project to monitor big horn sheep (Ovis canadensis nelsoni) within the US-93 project area. The first phase of the proposed project will allow for the monitoring of big horn sheep with GPS equipped telemetry collars to identify the patterns of movement of the sheep. The monitoring will provide transportation officials and resource managers with a better understanding of where in the project area the natural corridors of the big horn sheep are located. This will constitute the basis for enhanced decisions on the incorporation of design features better suited to reducing or preventing collisions between vehicles and wildlife along areas of proposed improvements to Highway 93. The research will also enable resource managers to identify key habitat features that are used disproportionate to their availability and minimize adverse impacts during the US-93 project's construction phase.

EXPECTED IMPLEMENTATION

The proposed research will be of direct relevance to the Environmental Planning and the Natural Resources Groups of ADOT. The work will also be coordinated with the Federal Highway Administration and other Federal, State, and local agencies – including the Forest Service, the Arizona Game and Fish Department, and the Bureau of Land Management.

Environment

STATUS OF THE RESEARCH

The project is ongoing, with good progress made.

TECHNICAL ADVISORY COMMITTEE (TAC)

John Reid,	Bureau of Land Management
Terry Brennan	US Forest Service
Jim Holland	US National Park Service
Justin White	ADOT Environmental & Enhancement Group
Melissa Maiefski	ADOT Environmental & Enhancement Group
Sam Elters	ADOT, Kingman District
Kara Hinker-Brambach	ADOT, Kingman District
Steve Thomas	Federal Highway Administration
Ron Kearns	Fish and Wildlife Service
Jim DeVos	AZ Game & Fish Department
Kevin Morgan	AZ Game & Fish Department

Project 584, FY 2005

Survey of Traffic Noise Reduction Products, Materials, and Technologies

Research Agency:	Prophecy Consulting Group	Program Date:	10/01/2005
Principal Investigator(s):	Ms. Vi Brown	Contract Date:	12/27/04
Contract Amount:	$7,980.00	Original Completion Date:	06/30/06
Program Budget:	10,000.00	Estimated Completion Date:	06/30/06
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	10,000	TRACS No.:	R058417P
Percent complete		Responsible ATRC Staff:	
Through 6/30/05	10%	(Project Manager)	Tom Kombe

PROBLEM STATEMENT

One of the most effective methods of controlling traffic noise is to reduce the noise generated at the source. One means to accomplish this is to absorb the sound on or near the roadway. Alternative noise barrier designs and treatments have been successfully utilized in other states and throughout Europe for a number of years to address different performance needs. In some situations these designs allow for the initial construction of a noise wall to be lower in height than a traditional wall. Also, retrofitting an existing wall with an innovative top section can reduce noise levels and eliminate the need for costly wall height increases or wall replacements. However, there is no comprehensive compilation of information on such traffic noise reduction products, materials, and designs.

RESEARCH OBJECTIVES

1. Determine what noise reduction products, materials, and technologies are currently available that have potential as noise mitigation alternatives.
2. Compile available performance information and discuss whether a full-scale testing program by the department is recommended.

EXPECTED IMPLEMENTATION

Based on the results of the tasks in this project, an assessment of the expected growth in the acceptability and use of the alternative noise mitigation approaches will be completed. The nature of, and amount of available quality performance information will also be determined. Recommendations will be developed on how ADOT can best proceed on this and whether a full-scale testing program is needed. Should such a testing program be recommended, ADOT will evaluate and decide accordingly.

STATUS OF THE RESEARCH

On-going.

Environment

TECHNICAL ADVISORY COMMITTEE (TAC)

Mike Dennis – ADOT Environmental & Enhancement Group
Fred Garcia – ADOT Environmental & Enhancement Group
Laura Tsosie – ADOT Environmental & Enhancement Group
Steve Thomas – Federal Highway Administration
Frank Darmiento – Transportation Research Center
Estomih (Tom) Kombe – ATRC Project Manager

Environment

Project 587, FY 2005

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

Research Agency:	Pending	Program Date:	10/01/2005
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	Pending
Program Budget:	$75,000	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$75,000	TRACS No.:	R058717P
Percent complete		Responsible ATRC Staff:	
Through 6/30/05	0%	(Project Manager)	Tom Kombe

PROBLEM STATEMENT

ADOT in the construction of highway projects over the last 10 years has transplanted substantial quantities of plant species that provide a major contribution to the area ecosystem and visual quality of highway projects. The cost of this planting on many projects can run $200,000 to $300,000 per mile. On SR 87 and US 93 heavy emphasis was placed on salvaging and transplanting of Saguaros, Ocotillo, Barrel and Yucca and some native trees. The plants salvaged and replanted on projects are watered one or two years after replanting as plant establishment. Because of the nature of the plants they may not show survival or mortality until they have been in the ground for 3 to 8 years. Since a number of plantings have been in the ground 5 to 10 years an inventory based on the projects' plantings with an evaluation of survival and mortality would benefit the planning, design and construction of projects.

The salvage and replanting of plant materials can have a major visual and ecosystem effect on projects. At the present time no evaluations have been made that can contribute to our knowledge basis and towards improvement of project design. The Department annually spends several hundred thousand dollars per mile on salvaging and replanting on projects throughout the state. This would be a valuable expenditure when considering the cost for success and failure related to planting and re-establishment of these unique plants on highway projects

The resulting benefits would include the following:

- Since many of the species planted are in a time period when their survival or mortality can be determined, assessing the survival and mortality rate would provide information on species that salvage well and have a high level of survival.
- Research the contributing factors for survival and mortality.
- Develop additional criteria selection for salvage for replanting.

RESEARCH OBJECTIVES

1. Quantify the effectiveness and survivability of the transplanting if native plants on highway projects.
2. Determine the level of survival and death of transplanted plants.
3. Assess factors that contribute to survival and mortality of transplanted plants.
4. Review information for improvement of projects requirements

Environment

EXPECTED IMPLEMENTATION

ADOT has a number of projects now reaching an age where salvage and replanting materials could be evaluated to provide effective determinations. An evaluation of salvage techniques and establishment techniques would enable the Department monies to be spent more effectively.

STATUS OF THE RESEARCH

Pending

TECHNICAL ADVISORY COMMITTEE (TENTATIVE)

LeRoy Brady,	Roadside Development, ADOT (Champion);
Representative -	Tonto National Forest;
Representatives -	Various District Construction ORGS;
Bruce Eilerts -	Natural Resource, ADOT;
Tammy Flaitz -	EEG, ADOT.
Thor Anderson	EEG, ADOT
Estomih Kombe	ADOT Project Manager, ATRC

Project 588, FY 2005

A *Study of the Effectiveness of Big Horn Underpasses on State Route 68*

Research Agency:	AZ G&F Department	Program Date:	10/01/2005
Principal Investigator(s):	Jim DeVos	Contract Date:	08/09/2005
Contract Amount:	$175,000	Original Completion Date:	12/31/2007
Program Budget:	$175,000	Estimated Completion Date:	12/31/2007
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$175,000	TRACS No.:	R058817P
Percent complete		Responsible ATRC Staff:	
Through 6/30/05	0%	(Project Manager)	Tom Kombe

PROBLEM STATEMENT

Habitat fragmentation by highways generally creates species declines. For bighorn sheep, size of contiguous habitat is a critical factor determining population persistence. Arizona consists of 32 isolated bighorn sheep ranges of varying sizes, the Black Mountains in northwestern Arizona being the largest (>500,000 acres). The range contains the largest desert sheep herd in the U.S., and represents 31% of Arizona's sheep population. The Black Mountain herd also provides an important source population for transplants. Upgrades to SR 68 and U.S. 93 could create three smaller isolated patches of bighorn sheep habitat in the Black Mountains

Highway underpasses are used nationally to mitigate the effects of habitat fragmentation, yet few performance evaluations have been conducted (Foreman et al. 2003). Two underpasses were installed in the Black Mountains along SR 68 for wildlife crossing; however, their effectiveness remains largely unknown. Little is known about bighorn sheep use of underpasses elsewhere, or the factors that influence sheep use of crossing structures. Information is needed to ensure proper placement and design of passages on this and future highway projects planned in the Black Mountains.

RESEARCH OBJECTIVES

1. Quantify the effectiveness of SR 68 highway underpasses in facilitating bighorn sheep habitat connectivity in the Black Mountains.
2. Determine physical and biological factors that influence bighorn sheep use of these underpasses.
3. Recommend modification to wildlife crossing structures if necessary.

EXPECTED IMPLEMENTATION

With the results of this evaluation ADOT will be able to make informed decisions when opportunities arise during maintenance and new roadway constructions, for the upgrade to and installation of wildlife crossing structures of proven effectiveness.

STATUS OF THE RESEARCH

A Joint Project Agreement was signed and recorded August 09, 2005.

Environment

TECHNICAL ADVISORY COMMITTEE (TAC)

Sam Elters	ADOT, Kingman District
Kara Hinker-Brambach	ADOT, Kingman District
John Reid,	Bureau of Land Management
Terry Brennan	US Forest Service
Jim Holland	US National Park Service
Justin White	ADOT Environmental & Enhancement Group
Melissa Maiefski	ADOT Environmental & Enhancement Group
Steve Thomas	Federal Highway Administration
Ron Kearns	Fish and Wildlife Service
Jim DeVos	AZ Game & Fish Department
Kevin Morgan	AZ Game & Fish Department

Project 589, FY 2005

Determination of 404 Permit and Habitat Restoration Requirements

Research Agency:	Pending	Program Date:	10/01/2005
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	Pending
Program Budget:	$125,000	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$125,000	TRACS No.:	R058917P
Percent complete		Responsible ATRC Staff:	
Through 6/30/05	0%	(Project Manager)	Tom Kombe

PROBLEM STATEMENT

ADOT recognizes that with the construction of highway projects and to waters of the U.S. and important habitat areas that there is an opportunity to re-establish and enhance quality wildlife habitat areas. The present Permits frequently require planting on a replacement of 3 to 1 with up to 80% survival in the fifth year of the permit. Based on review of these permit areas it is becoming apparent that these requirements are beyond a naturally sustainable level with a number of projects falling short of these requirements. Since habitat and native planting has not been studied these criteria are based on assumptions beyond what the various ecological systems appear to be able to support especially in a drought.

The present 7-year drought that we are experiencing has a very direct effect on the survivability of the plantings. At the present time no one area can provide information from which to make evaluations and determinations which would provide a basis for new project plantings and specifications. Values that are appearing with projects require additional time and effort of the various staff resources in setting up new projects and addressing value issues.

The resulting benefits would include the following:

- ADOT will be able to develop guidelines that recognize most successful species for planting for habitat restoration.
- Restoration of areas has a benefit not only to wildlife but also from a visual standpoint of the highway traveler.
- Development of guidelines would establish some uniformity and a basis for negotiations for 404 Permits (Clean Water Act, Section 404, regulating waste discharges to Waters of the United States) and habitat replacement with other agencies.
- At the present time with values on existing projects, replanting is expensive and may be non-productive.

RESEARCH OBJECTIVES

1. Determine the 404 Permit and habitat restoration permits that are under construction and within the reporting period for completion (3 to 5 years)
2. Assess the conditions of the plantings towards meeting the requirements for completing the 404 Permit or habitat restoration mitigations.

3. Based on the assessments of developed criteria and guidelines for the 404 Permits and habitat replacements

EXPECTED IMPLEMENTATION

At the present time we estimate ADOT spends over several thousand dollars a year for plantings on various projects throughout the state. Evaluations 3 or 4 years after these plantings are being made are beginning to indicate that many of these plantings are being made beyond the naturally sustainable level. The research would provide additional direction to the Department on realistic expectations and commitments.

STATUS OF THE RESEARCH

Pending

TECHNICAL ADVISORY COMMITTEE (TAC)

LeRoy Brady, Manager Roadside Development, ADOT (Champion);
Tammy Flaitz, Asst. Environmental Program Manager, ADOT;
Thor Anderson, Environmental Planning, ADOT;
Bruce Eilerts, Natural Resources Manager, ADOT
Estomih Kombe, ADOT Project Manager, ATRC

Project 600, FY 2005

Effectiveness of Microbe Application to Petroleum Spills at Crash Sites

Research Agency:	Pending	Program Date:	10/01/2006
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	Pending
Program Budget:	$15,000	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$15,000	TRACS No.:	R060017P
Percent complete		Responsible ATRC Staff:	
Through 6/30/05	0%	(Project Manager)	Tom Kombe

PROBLEM STATEMENT

Hundreds of private and commercial vehicles crash on ADOT roadways yearly, often releasing fuel tank and engine contents onto ADOT property. This may result in soil contamination above regulatory action levels. Runoff from roadways is a nationally recognized storm water quality threat, prompting the California Department of Transportation, for example, to build extensive storm water protection devices. Storm water quality issues at ADOT have been addressed by a consent decree from ADEQ.

Petroleum releases from crashes pose a threat to storm water quality (both natural rain and runoff from fire departments at the crash site) and adjacent soils. One method commonly used to mitigate petroleum-contaminated soils is the application of petroleum-eating microbes to affected areas. ADOT would benefit from a research project, which would begin to answer these questions:

1. What environmental benefit, as measured by standard soil testing, might ADOT expect to obtain from applying a microbe solution to crash site spills as part of our first response to the incident?
2. How much would it cost to equip ADOT response teams to apply microbe solution?

LITERATURE SEARCH

The TRIS database contains 97 abstracts on storm water topics and 2 abstracts on petroleum contaminated soils. The Research in Progress database contains 43 abstracts on storm water topics and 1 on petroleum-contaminated soils. None were found that examined the impact of microbe application on a per-release (per crash, in this case) basis.

RESEARCH OBJECTIVES

1. Assess the effectiveness of microbe application by analyzing treated and untreated samples in a controlled field environment.
2. Determine the cost per response vehicle of preparing teams to apply microbe solution.
3. If applicable, recommend one or more microbe products for use by first response teams.

RESEARCH TASKS

- Meet with project TAC to review the scope of work and work plan.

- Review the existing literature on microbe application, including asking microbe product manufacturers for input on applicable research.
- Select a research site or sites as necessary.
- Prepare, maintain, sample, and clean up test plots
- Prepare a detailed final report.
- Present results to the Research Council.

EXPECTED IMPLEMENTATIION

The research will provide data that will enable the Agency to decide if it is cost effective to provide crash response teams with microbe application capability. Process owner of the study would be the Safety and Health Section. If implemented, the microbe application process would be owned by local maintenance groups/teams.

ADOT INVOLVEMENT

ADOT will provide property for the test plots as well as manpower for plot seeding and study oversight (Jeff Page, Safety and Health Section, will lead this effort). Site preparation may require the services of 2 Highway Maintenance Technicians.

STATUS OF THE RESEARCH

Scope of work definition and contract preparation tasks are ongoing.

TECHNICAL ADVISORY COMMITTEE

Jeff Page - Safety and Health Section, Project Champion.
Courtney Perrier-Be - ADOT Emergency Response
Craig Cornwell and/or John Hauskins - District Maintenance
John Semmens - ATRC
FHWA representative
Estomih Kombe - ATRC Project Manager.

Project 601, FY 2005

Cost Evaluation of Cross Border Truck Emissions Testing using Heavy Duty Remote Sensing (HDRS) Equipment

Research Agency:	Pending	Program Date:	10/01/2006
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	Pending
Program Budget:	$15,000	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$15,000	TRACS No.:	R060117P
Percent complete		Responsible ATRC Staff:	
Through 6/30/05	0%	(Project Manager)	Tom Kombe

PROBLEM STATEMENT

Trucks at Arizona Land Ports of Entry (LPOE) will soon be required to comply with new emissions standards set by the Environmental Protection Agency (EPA). The Arizona Department of Transportation (ADOT) is now responsible for Truck Safety inspections at the Border - Ports of Entry (LPOE). Trucks are to be detained at the border for these required emissions tests and this will likely occur alongside the current ADOT safety check.

Testing of truck emissions by remote sensing will promote fast tracking of trucks across the border and insure the required emissions testing programs will minimize border congestion. ADOT is in the process of upgrading and remodeling Arizona's LPOE. The design phase of these port improvements would be the ideal time to incorporate this new emission program.

EPA is currently establishing a comprehensive national control program that will regulate heavy-duty vehicle emissions. As part of this program, new emissions standards will begin in vehicle model year 2007.

PROJECT OBJECTIVES

The study objective is to perform a thorough evaluation of the feasibility and cost implications, initial installation and program costs, for a port of entry truck emissions program utilizing remote sensing technology.

PROPOSED RESEARCH

This research will study costs to test truck emissions at border crossings with Remote Sensing Technology. This involves projecting costs to install the Heavy Duty Remote Sensing (HDRS) equipment in the "Fast Lanes" at ADOT ports and also the costs of ongoing testing with HDRS.

ANTICIPATED BENEFITS

Developing border truck emissions control-testing strategies that employ remote sensing technology will provide the mitigation of congestion and fast tracking of trucks across the border. In turn this reduces air pollution at these sites from trucks idling for long periods.

Environment

EXPECTED IMPLEMENTATION

The first step will be to review current Remote Sensing technology and the costs to implement and maintain this technology at a LPOE. Using the results of this study ADOT will be able to make an informed evaluation to determine where this technology would be most useful and if applicable, how soon ADOT would be able to incorporate this into its testing program.

STATUS OF THE RESEARCH

Scope of work definition and contract preparation tasks are ongoing.

TECHNICAL ADVISORY COMMITTEE

Kathleen Sommer, TPD Air Quality Programs (ADOT Champion)
Beverly Chenausky, TPD Air Quality Programs
Timothy Lee, Revenue Audits – MVD
Randy Sedlacek, Arizona DEQ
Ed Stillings, FHWA
Estomih Kombe, ADOT Project Manager -ATRC

Project 602, FY 2006

Sampling and Analyses of Storm Water Runoff on the Red Mountain Freeway - Loop 202

Research Agency:	Pending	Program Date:	10/01/2006
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	Pending
Program Budget:	$40,000	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$40,000	TRACS No.:	R060218P
Percent complete		Responsible ATRC Staff:	
Through 6/30/05	0%	(Project Manager)	Tom Kombe

PROBLEM STATEMENT

Storm water runoff associated with the Red Mountain Freeway (Loop 202) between Gilbert Rd. and Lindsey Rd discharges into two detention basins and a pump station prior to discharging into the Salt River. This storm water discharge is an important issue because it may carry a wide range of pollutants including nutrients, trash and debris, sediments, heavy metals, pathogens, petroleum hydrocarbons, and synthetic organics such as pesticides. Storm water runoff does not originate from a distinct "point" source (e.g., an industrial discharge pipe), and is often referred to as "non-point" source pollution. Currently, no data is available concerning this type of storm water runoff from Arizona Department of Transportation (ADOT) highways into such waterways. Acquiring this data will assist ADOT in determining appropriate best management practices (BMPs) to implement and how best to protect surface water quality.

LITERATURE SEARCH SUMMARY

A review of on-line literature from the Transportation Research Information Services (TRIS) at http://ntl.bts.gov/tris and the Research In Progress database located at http://rip.trb.org/search revealed several relevant studies, cited on the next page.

RESEARCH OBJECTIVES

The objective of this monitoring program is to characterize the storm water entering each detention basin and the storm water entering the Salt River. Acquiring this data will allow ADOT to evaluate the effectiveness of its BMPs being implemented along this portion of the Loop 202.

AFFECTED SECTIONS

Others affected by this include the City of Mesa, the Maricopa County Flood Control District, and the Arizona Department of Environmental Quality.

ANTICIPATED BENEFITS

The benefits from this study will give ADOT baseline data in determining what contaminants, if any, are entering the Salt River. The results of this data will be used to determine if BMPs are sufficient to protect surface water quality and to adjust BMPs as necessary.

Environment

EXPECTED IMPLEMENTATION

ADOT's Central Maintenance group will be responsible for implementation of this project and overseeing sampling activities.

STATUS OF THE RESEARCH

Scope of work definition and contract preparation tasks are ongoing.

TECHNICAL ADVISORY COMMITTEE

LeRoy Brady, Roadside Development Manager (ADOT Champion)

Project 603, FY 2006

Evaluation of Measures to Minimize Wildlife-Vehicle Collisions & Maintain Wildlife Permeability – Kohls Ranch Section, State Route 260

Research Agency:	Pending	Program Date:	10/01/2006
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	Pending
Program Budget:	$166,313	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$166,313	TRACS No.:	R060318P
Percent complete Through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	Tom Kombe

PROBLEM STATEMENT

Under Phase I (2004-2004) of the SR 260 research project we recorded 4,001 animals with video camera systems at the 1st 2 underpasses (UP), comparing use (e.g., 68% passage rate) and behavioral response. Based on this data, ADOT made major design changes to the UP on the Kohls Ranch (KR) Section. We accrued 101,500 fixes from 33 elk fitted with GPS satellite tracking collars, and identified 3,057 highway crossings and assessed permeability. This data was used to determine the extent of elk-proof fencing needed to intercept and funnel elk to UP, maximizing UP effectiveness. In the KR Section, adding fencing to 25% of the section is projected to intercept 60% of the elk crossings. We compared GPS crossings to nearly 500 wildlife-vehicle collisions (WVC) from 1994-2004, and compared collisions before and after highway reconstruction. Under Phase II (2004-2006), we've fitted 29 elk and 7 whitetail deer with GPS collars. Video surveillance has been ongoing at 4 UP on the Christopher Creek (CC) Section since 2004, with 1,158 animals recorded; passage rates have been low (23%). With additional UP video assessment, we will be able to conduct multivariate analysis of factors affecting wildlife use and UP effectiveness and assess long-term changes in usage. This project will provide long-term data on wildlife use of UP and permeability, as well as assess the effectiveness of adaptive management changes made on the KR Section.

RESEARCH OBJECTIVES

1) Analyze collisions to assess effectiveness of UP and fencing in reducing WVC, 2) install video camera system to assess wildlife use of the new KR Section UP, 3) fit 6 elk with GPS collars on the KR Section, and track those collared in Phase II to assess elk permeability after reconstruction, 4) continue to monitor the 6 UP with video systems already in place to yield long-term data, and 5) continue to work closely with ADOT managers to improve the effectiveness of wildlife measures.

AFFECTED SECTIONS

Intermodal Transportation Division, Environmental Planning Section, Natural Resources Management Section, ATRC, ADOT Risk Management, and others. External: Forest Service, FHWA, and others.

ANTICIPATED BENEFITS

1) Highway safety - WVC reduction, 2) enhanced long-term research and insights for future application, 3) increased effectiveness of wildlife measures, 4) enhanced standing for ADOT on liability issues involving WVC, 5) enhanced decision making on future highway applications, 6) continued commitment to sound project management principals, 7) national leadership in innovative application of UP.

EXPECTED IMPLEMENTATION

The results of our management-oriented research will support ongoing adaptive management with ADOT to develop and implement effective UP structures and determine fencing needs. Insights from this research will be used to develop guidelines for future UPs, and will be published in scientific journals.

STATUS OF THE RESEARCH

Scope of work definition and contract preparation tasks are ongoing.

TECHNICAL ADVISORY COMMITTEE

Bruce Eilerts (ADOT Champion)
ADOT Risk Management representative

Mike Ross	Tonto National Forest
Earl (Duke) Klein	Tonto National Forest
Doug Brown	AZ Dept. of Administration
Norris Dodd	AZ Game & Fish Dept., Research Leader
Ray Schweinsburg	AZ Game & Fish Dept.
Steve Thomas	Federal Highway Administration
Terry Brennan	Tonto National Forest
Melissa Maiefski	ADOT Environmental & Enhancement Group
Tom Kombe	ADOT Research Project Manager, ATRC

Intelligent Transportation Systems (ITS)

Project 473, FY 1998

Arizona Intelligent Vehicle Research

Research Agency:	Arizona Transportation Research Center	Program Date:	10/09/97
Principal Investigator(s):	ATRC Staff (Owen)	Contract Date:	None
Contract Amount:	None (in-house)	Original Completion Date:	06/30/98
Program Budget:	$70,000	Estimated Completion Date:	06/30/06
Expenditures to date:	$64,832	Is project on schedule?	Yes
Available Amount:	$5,168	Advantage No.:	R0473 14P
Percent complete through 6/30/2005:	99%	Responsible ATRC Staff: (Project Manager)	Steve Owen

PROBLEM STATEMENT

This Intelligent Vehicles (IV) project was the result of ADOT visits to the National Automated Highway Systems (AHS) Demonstration in San Diego, California in 1997. After several early AHS demonstrations in Arizona, the project then evolved to focus on ITS driver assistance and snowplow guidance technology for ADOT maintenance crews in severe winter storm conditions.

The Arizona Transportation Research Center conducts this project in-house. Seven winters of testing and evaluation have now been completed. ATRC formal project reports were published in February 01, May 02, September 03 and January 04 for five winters of research. An interim report, on implementation in the sixth year, was released internally in August 2004. Another internal report on the seventh winter (04-05) will be done in late 2005. The ATRC will continue to monitor implementation into 2006, supporting field evaluation of snowplow warning systems.

RESEARCH OBJECTIVES

The key objective of this ongoing project is to continue, and to implement, advanced snowplow research. A second objective is to pursue further research into intelligent vehicle systems, as it may eventually lead to deployment of advanced vehicles and dedicated lanes in Arizona.

EXPECTED IMPLEMENTATION

This ongoing project will identify promising areas for deployment of ITS-IV systems in Arizona. It will conduct research, tests and demonstrations as warranted in the areas of vehicle guidance and warning systems, and related ITS technology. The current focus is on new technologies to improve safety and efficiency of winter maintenance in Arizona conditions, and to promote implementation and further local evaluation of these systems.

STATUS OF THE RESEARCH

Initial project efforts evaluated Intelligent Vehicle technology for congestion relief. A concept study was done on dedicated AHS lanes on I-10 from Phoenix to Tucson. A demonstration of magnet-guided, fully automated cars was conducted in late 1997 on a closed course in Tempe. Another on-highway demonstration in early 1998 employed cars with machine-vision guidance.

ADOT's current focus is winter maintenance. In 1998, ADOT joined the California Department of Transportation (Caltrans) to evaluate a prototype Advanced Snowplow (ASP), the Caltrans

RoadView system. ADOT began tests of the Caltrans magnets in early 1998, and a six lane-mile test site was constructed on US 180 near Flagstaff in 1998 and 1999. The Caltrans ASP vehicle was shipped to Arizona for one month of training and testing each winter, for four years.

In 2000, after two years with Caltrans, driver-assistance systems were added to an ADOT snowplow, and 3M Company installed five miles of magnetic tape on US 89 near Sunset Crater. Winter tests of this 3M Lane Awareness System in 2000-01 and 2001-02 were a success.

After four winters of training and evaluations of the Caltrans and 3M guidance systems, the TAC shifted the research to less complex commercial on-board warning systems for low visibility conditions. It was clear that these roadway-infrastructure systems were too costly for ADOT, which concluded in early 2002 that true whiteout storm conditions were not frequent enough in Arizona to justify the advanced, semi-automated systems.

The TAC directed ATRC to study two commercial on-board warning systems for low-visibility conditions – Eaton VORAD Collision Warning Radar and Bendix XVision infrared night vision. ATRC acquired four radar and three night vision systems. Seven maintenance camps in three districts each received a test system for one of their snowplows by January 2003. That winter was mild and dry, with only limited results. This was the last full winter of active research, the monitoring of a regional deployment. Project report 473(4) was published in January 2004 on the concepts and issues encountered with the 02-03 deployment of on-board warning systems.

This research program has continued for two more winters of implementation support. ATRC completed a full winter of testing and evaluation in 2003-04 (yet another dry season). Results were summarized for the TAC in a brief internal report (August 04). For 2004-05, a wet winter season gave the seven warning systems a good test, at last, but individual results were still mixed due to driver and route variability.

While the research work is complete, the project will remain active for another winter to support further implementation, operational use, and maintenance of the seven on-board warning systems in northern Arizona. Also, several low-cost blind spot / rear warning radar units may be tested.

TECHNICAL ADVISORY COMMITTEE (TAC)

Sam Elters, Rance Spurlock, Tom Steinberger and Bruce Mejia	ADOT – Kingman District
John Harper, Kent Link, Danny Russell, Ernie Sanchez, Tim Bighorse, Mike Gutzwiller	ADOT – Flagstaff District
Dave Sikes, Randy Routhier, Robert Wilbanks, Frances McCauley, and Gilbert Nastacio	ADOT – Holbrook District
Dennis Halachoff, Larry Presnall, Carl Eyrich, Steve Carspecken, Jose Servin, Dean Murgiuc	ADOT Equipment Services
Lt. Jim Gerard	Arizona Department of Public Safety
George Howard	National Weather Service
Tim Wolfe, Manny Agah	ADOT Transportation Technology
Alan Hansen	Federal Highway Administration

Intelligent Transportation Systems (ITS)

Project 557, FY 2003

Railroad & Highway Crossing Cooperative Signal Control

Research Agency:	Northern Arizona University	Program Date:	10/01/02
Principal Investigator(s):	Dr. Craig Roberts	JPA 02-209 Date:	03/14/03
Contract Amount (SPR):	$155,000	Original Completion Date:	09/30/04
Project Budget:	$155,000	Estimated Completion Date:	10/31/05
Expenditures to date:	$136,047	Is project on schedule?	No
Available Amount:	$18,953	TRACS No.:	R0557 15P
Percent complete through 6/30/05	90%	Responsible ATRC Staff: (ITS Project Manager)	Steve Owen

PROBLEM STATEMENT

Railroad grade crossings create traffic control problems that severely impact traffic flow. Safety problems occur in urban areas when a street that feeds into a parallel arterial has a grade crossing near that intersection. Here, the left and right-turn arterial stacking lanes may overflow onto the parallel arterial mainline as a passing train blocks the minor street. At Flagstaff, this condition exists on SR 89 / Route 66 at the Enterprise Road intersection, with nearly 100 trains per day.

Many rural towns along rail corridors have this problem, as do the Pima and Maricopa County metropolitan areas. All recognize the issues, and support the search for remedies. Severe safety problems occur in semi-rural areas at grade crossings for feeder roads at freeway interchanges, leading to long blockages of peak hour traffic and severe congestion. Even worse, overflows of queued vehicles onto the freeway mainline can occur as ramp capacity is exceeded.

In many of these cases where highways and railroads are parallel, ADOT manages the affected traffic signals. ADOT currently has approximately 30 traffic signals with train preemption. Increases in both train traffic and vehicular traffic are predicted, as Arizona continues to grow.

RESEARCH OBJECTIVE

The project goal is to develop site-specific, enhanced train clearance algorithms that can provide significantly more “green time” before the arrival of a train, to reduce overflows and congestion.

ITS technology can monitor train speed, acceleration, deceleration, and length far in advance of current systems that give a minimum 20 seconds of warning time. This data can enable new site-specific prediction models of train arrival times and crossing durations. Operating in real-time, such models can provide very early predictions to intersection signal controllers. Also, Dynamic Message Signs can communicate real-time delay-warning information to motorists.

The hardware for this ITS application already exists, and existing microscopic simulation software can be modified to provide real-time traffic data for individual vehicle movements, enabling an actuated controller to control the site signals. This software-hardware interfacing, or “hardware-in-the-loop” simulation, is an effective prototyping tool. These site-specific ITS prototypes can be rigorously evaluated using multiple Measures of Effectiveness. Hardware-in-the-loop simulation, with site-specific prediction models and control algorithm development offers ADOT a very high level of risk reduction for deployment in the future.

Intelligent Transportation Systems (ITS)

The following phases of research will be performed:

1. Sites selection, development of off-track detection methods, and site data collection.
2. Development of site-specific train arrival prediction models.
3. Prototyping ITS signal processing and microscopic simulation of site traffic.
4. Hardware-in-the-loop prototype development, site-specific controller algorithm development.
5. Total system prototype validation using second data set.

EXPECTED IMPLEMENTATION

The only effective solution currently is grade separation structures, but the need and the cost far outstrip ADOT's ability to build them. The result of this applied research will be a congestion-mobility management tool for these situations, as growth continues and as traffic increases.

This project will benefit both the public and ADOT with regard to safety and to congestion-mobility management. Benefits of future application of this research will include:

- Saving lives at grade crossings by reducing the delay and the temptation to run the gates.
- Reducing the danger of queues that back up onto the freeway from the blocked grade crossing, and the potential for rear-end collisions on the mainline.
- Similar queue backup problems will be reduced on arterial street crossings.
- Reducing traffic delays and congestion, and improvements in regional air quality.
- Providing valuable delay inputs to Traveler Information Systems in the area.

STATUS OF THE RESEARCH

This project was initiated through a JPA with the University in March 2003. Acquisitions of equipment, modeling software training, and field data collection were initial activities. VISSIM model development was completed and signal control scenarios were developed to establish the critical proof of concept. An independent evaluation was done in mid-2005 to validate the NAU modeling. The Final Report is in progress, targeted for late 2005. A Phase 2 effort was scoped but is deferred, as the NAU Principal Investigator will be on sabbatical leave during 2005-06.

TECHNICAL ADVISORY COMMITTEE (TAC)

Tim Wolfe	Transportation Technology Group
John Harper, Chuck Gillick	Flagstaff District
Sam Elters, Rance Spurlock	Kingman District
Tom Goodman, Mike Lessard, Ann Phillips	Traffic Engineering
Ken Cooper	Roadway Standards
George Wendt	Risk Management
Gerry Craig, Steven Hill	City of Flagstaff
David Wessel	Flagstaff MPO
Dennis Roberts, Debbie Casson	City of Kingman
Mike McCallister, Dan Owsley	Burlington Northern Santa Fe Railway
Alan Hansen	Federal Highway Administration

Intelligent Transportation Systems (ITS)

Project 569, FY 2004

Transportation Communications Interoperability Phase 2 – Resource Evaluation

Research Agency:	ITS Engineers	Program Date:	10/01/03
Principal Investigator(s):	Michael Wendtland Richard Tannehill	Contract (or JPA) Date:	07/01/05
Contract Amount (*Part A*):	$50,000	Original Completion Date:	N/A
Project Budget:	$150,000	Estimated Completion Date:	12-31-05
Expenditures to date:	$0	Is project on schedule?	TBD
Available Amount:	$150,000	TRACS No.:	R0569 16P
Percent complete through 6/30/05:	0 %	Responsible ATRC Staff: (ITS Project Manager)	Steve Owen

PROBLEM STATEMENT

Communication is the key to all ADOT operations, from daily construction and maintenance to events to incidents to regional security issues. A critical need exists for secure communications with transportation and emergency response partners at all levels.

Radio interoperability technology can overcome the lack of a common frequency, channel, or system between agencies. Interoperability is a statewide need for incident management and in security situations, and is the core goal of a long-term (2010+) communications strategic plan by the Public Safety Communications Commission (PSCC) and the Department of Public Safety.

RESEARCH OBJECTIVES

This Phase 2 Resource Evaluation study builds upon recent SPR-561 Needs Assessment research (Phase 1) into the current status of ADOT and DPS radio communications, the frequencies and systems currently in use across the state, and ADOT's priorities for near-term solutions. This new project will evaluate near- and mid-term solutions for day-to-day communications issues in the statewide transportation environment.

The Phase 1 Needs Assessment addressed ADOT's core goals by developing long-term action plans, and by scoping five key near- to mid-term interoperability pilot projects, *three of which are already implemented* by ADOT. Project 569 will deploy and evaluate two other ADOT-DPS pilot projects as potential solutions for current system constraints and interagency issues.

With small-scale pilot projects, this Phase 2 study will validate the near-term recommendations of SPR 561 for ADOT and DPS to address their joint statewide roles, needs and responsibilities. The regional pilot deployment, if successful, will support statewide radio system upgrades, and implementation strategies will also be refined. *Task A of this project is the Design Phase*.

PROJECT APPROACH

- Task A - Design of *Pilot Project 4*: ADOT-VHF mobile radios installed in DPS patrol units on the I-40 and/or I-17 Corridors (base quantity defined by research budget – 12 to 18 units). The proposed deployment area, number of radios, base case budget, any supplemental funds, and the training and evaluation plans will be determined in this design phase for Pilot Project 4.

- Task A - Design of *Pilot Project 5*: Create radio gateway links, communication upgrades, and system upgrades for selected key ADOT and DPS Dispatch consoles (base case is the ADOT Phoenix TOC and DPS Phoenix OpComm Center). It will define the best approach to expansion and reprogramming of both the TOC console system, and the DPS central system, as well as any additional equipment. The actual extent of deployment, the budget elements, and the training and evaluation plans will be determined in this Pilot Project 5 design phase.

Approach - Task B:

- A second task order will be developed, based on results of Task A, to perform Task 569-B: the field deployment, monitoring, evaluation, project management and reporting.

- The research budget will provide limited, baseline funding for minimal pilot project 569-B radio equipment deployment, to the extent needed to establish a sound evaluation basis.

- Supplemental funds for additional hardware and equipment to expand the geographic area of pilot project 569-B will be sought from internal ADOT and DPS sources.

EXPECTED IMPLEMENTATION

The communications resources to be evaluated in the SPR 569 Phase 2 project will enhance both day-to-day and emergency operations, and effectiveness, for ADOT and DPS in their key roles. It will provide better field communications in the pilot project areas, and better coordination and resource utilization with DPS.

Key benefits of this project include more timely and effective ADOT responses in all multi-agency emergencies, and improved transportation facility security. It is expected to justify near-term statewide applications of the key Phase 1 recommendations.

STATUS OF THE RESEARCH

This project is to be initiated in July 2005, with Notice to Proceed released in late June.

TECHNICAL ADVISORY COMMITTEE (TAC)

Tim Wolfe	Transportation Technology Group
Jeff Page, Sonya Herrera	Safety & Health
Scott Grissom, Lori Elzy	MVD Enforcement
John Harper, Kent Link	Flagstaff District
Steve Puzas	Safford District
Manny Agah	Traffic Operations Center
Lonnie Hendrix	Central Maintenance, ADOT Homeland Security
John Hauskins, Greg Gentsch	Phoenix Maintenance District
Curt Knight	Arizona Public Safety Communications Committee
Scott Tillman, Steve Golisch	Arizona DPS Telecommunications
Alan Hansen	Federal Highway Administration

Project 585, FY 2005

Snowplow Simulator Training Evaluation

Research Agency:	Arizona State University	Program Date:	10/01/04
Principal Investigator(s):	Dr Mary Kihl	JPA 05-010T Date:	11/04/04
Contract Amount (SPR):	$ 99,974	Original Completion Date:	12-31-06
Project Budget:	$100,000	Estimated Completion Date:	Same
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$100,000	TRACS No.:	R0585 17P
Percent complete through 6/30/05	40%	Responsible ATRC Staff: (Project Manager)	Steve Owen

PROBLEM STATEMENT

Snowplow operators face the most demanding set of operating tasks in the worst weather and traffic conditions. They work long and stressful shifts in snowstorms at any hour of any day throughout the winter. ADOT operators must not only drive a $200,000 snowplow safely, but also must operate spreader and plow controls, monitor the truck's instruments and radios, and stay focused on the weather and highway surface conditions, and on the traffic around them.

Current operator training, with limited budgets and manpower shortages, often consists of sending out new drivers into winter storms with a partner-mentor-trainer for only a few work shifts, at best. For this level of skill and responsibility, such training is just marginally adequate.

ADOT will conduct a pilot program of snowplow operator training with new state-of-the-art simulator technologies. This research will test the effectiveness of realistic situational driver training in a safe off-highway environment. Simulator training can build decision-making skills for emergency situations before operators go out alone on winter roadways. Driver safety and equipment value both justify the development of an improved, more effective training program.

RESEARCH OBJECTIVES

ADOT's ITD training staff will contract first-year training services from the snowplow-simulator system developer, while working towards procurement of an ADOT simulator for Year Two. The goal of this evaluation research is to support and document the simulator training activity, and the long-term snowplowing safety record of the pilot program trainees. The primary task elements of this research effort are:

- Develop a detailed evaluation plan with the project's Technical Advisory Committee (TAC).
- Monitor the outsourced first-year training of a mixed group of new and experienced ADOT snowplow operators.
- Formally evaluate the safety performance of the driver trainee groups for two winter seasons.
- Provide a first-year interim report including recommendations for program expansion in the second year with ADOT simulator(s) and training staff.
- Monitor ADOT's standard training activity and the long-term safety performance of a pool of non-simulator trained drivers over two winters.

- Report on the documented safety performance of the simulator-trained driver pool and the control group; report on other relevant driver performance criteria and cost issues for the program, as defined for the evaluation plan by the project's TAC.

EXPECTED IMPLEMENTATION

The results of this research will justify and support the future expansion of training-simulator facilities by ADOT for its equipment operators, both for the State's critical snowplow operations and potentially for other types of heavy equipment training. Future options for ADOT include the purchase of its own simulators, a lease program, or ongoing vendor training.

Improved driver skills and confidence will enhance the safety of ADOT snowplow operators. This in turn will provide better road conditions, improved driving safety, and enhanced schedule reliability both for the motoring public and for time-sensitive commercial freight operations.

Equipment operator retention may be measurably improved if better training enhances skills and confidence. This may reduce overall driver stress levels, increase job satisfaction, and improve performance in emergencies. Further significant value may be derived from reduced crashes and incidents involving ADOT fleet units and the public.

STATUS OF THE RESEARCH

A Year One interim report is under development by ASU, describing the results for 149 ADOT snowplow operators who were trained by the simulator vendor in December 2004.

Year Two planning is underway. The first permanent ADOT simulator is to be delivered to the Globe District in late August. Once trained as instructors, ADOT Globe staff will conduct a simulator-integrated winter maintenance-training curriculum for 80 to 85 snowplow operators in the Fall. The ASU team will focus their Year Two analysis on Globe's results for 2005-06.

TECHNICAL ADVISORY COMMITTEE (TAC)

Erika Martinez	ITD Technical Training (Champion)
Annie Parris	ITD Technical Training
Dennis Halachoff	State Equipment Services Manager (Champion)
Jerry Massie, Bill Kohn, Dell Jenkins	Equipment Services Fleet Management
Rick Powers	Globe District Engineer (Sponsor)
JoAnn Noriega	Globe District Training Coordinator
John Harper	Flagstaff District Engineer (Sponsor)
Dennis Johnson	Williams Maintenance Supervisor (Flagstaff District)
George Garcia, Jr.	Flagstaff District Training
Carl Eyrich	Flagstaff Equipment Shop
Sue Olson, Cindy Eiserman	Risk Management Section
Diane Minton	State Engineer's Office
Reed Henry	Traffic Engineering Group
Rick Ammon	Safety & Health Section
Alan Hansen	Federal Highway Administration

Intelligent Transportation Systems (ITS)

Project 595, FY 2004

Real-time Adaptive Ramp Metering: Phase 1 - Simulation & Implementation

Research Agency:	University of Arizona	Program Date:	10/01/03
Principal Investigator(s):	Dr. Pitu Mirchandani	JPA 05-015T Date:	12/29/04
Contract Amount (SPR):	$100,00	Original Completion Date:	6-30-06
Project Budget:	$100,000	Estimated Completion Date:	3-31-06
Expenditures to date:	$ 12,261	Is project on schedule?	Yes
Available Amount:	$87,739	TRACS No.:	R0595 16P
Percent complete through 6/30/05	40%	Responsible ATRC Staff: (Project Manager)	Steve Owen

PROBLEM STATEMENT

ADOT's Freeway Management System is designed to apply "smart" ramp metering, taking into account the impacts on mainline freeway traffic flow. However, since its inception, smart real-time traffic-adaptive ramp metering has never been implemented.

Planned FMS controller upgrades, and existing communication infrastructure, would allow the full utilization of new ramp metering control strategies, such as the U of A's traffic-adaptive MILOS program, on extended freeway corridors. Such "smart" corridors will make ramp-metered traffic flows smoother and improve the operation of system interchanges and connecting corridors in the region. This project's corridor simulation modeling would validate the traffic-adaptive concept (this Phase 1), and will justify its early implementation when the FMS is upgraded (a future Phase 2 effort, to be based on results of this project's simulations).

RESEARCH OBJECTIVES

ADOT's Transportation Technology and Traffic Engineering Groups will support the research effort in coordination with planned near-term Freeway Management System upgrades, as well as new FMS construction, in the Phoenix metropolitan area. The objectives of this research phase are three-fold:

1. Collect traffic data for selected freeway corridors and regions of the Valley.
2. Develop corridor and region-wide simulation models to evaluate UA's traffic-adaptive MILOS, and similar programs, against the current fixed-time and traffic-responsive systems.
3. Run the simulation models and analyze performance of all three strategies, studying the key congestion measures including bottlenecks, travel times, and smoothness of flows.

EXPECTED IMPLEMENTATION

This research will enable the full utilization in the near future of traffic-adaptive concepts and capabilities for which a platform is already designed in the ADOT FMS system. Significant benefits including reduced congestion, reduced emissions and improved safety.

This project will establish the basis for field evaluations of the most promising smart ramp metering system, when the planned hardware upgrades have been completed for the Valley's Freeway Management System.

Intelligent Transportation Systems (ITS)

STATUS OF THE RESEARCH

This project was initiated in December 2004, and it as proceeded, as planned, with direction and support from the TAC group. The best focus of the study was determined to be on a six-mile segment of Interstate-10 through the southeast Phoenix-Tempe-Chandler area. These three cities are now actively participating on the TAC. The site corridor on I-10 extends generally from Chandler Boulevard to the Broadway Curve (Southern Avenue), with a dozen metered ramps.

The ramp meter controllers in the selected study corridor were being upgraded as of mid-2005, which allowed the UA team to employ the newest software interface (Siemens i2) and to utilize a loaned controller at their ATLAS Center facility in Tucson. At mid-year, work is in progress and on schedule on operating scenarios, MILOS modeling, and interface software development.

ADOT's Research Council approved a Phase Two "on-and-off" MILOS field evaluation in June, for FY 2006 funding (*see also* SPR 604).

TECHNICAL ADVISORY COMMITTEE (TAC)

Tim Wolfe	Transportation Technology Group (Champion)
Manny Agah	Transportation Technology Group – TOC Manager
Darrell Bingham, Glenn Jonas, Lydia Warnick, and Jerry Pfeifer	Transportation Technology Group – TOC
Tom Parlante	Traffic Engineering Group
Joe McGuirk, Sonny Sollano	Phoenix Maintenance District
Sarath Joshua	Maricopa Association of Governments (MAG)
Dave Wolfson	Maricopa County DOT
Jim Decker, Christine Warren	City of Tempe
Ron Doubek	City of Phoenix
Brian Scifers, Ben McCawley	City of Chandler
Alan Hansen	Federal Highway Administration

Intelligent Transportation Systems (ITS)

Project 604, FY 2006

Real-time Adaptive Ramp Metering: Phase 2 – Implementation and Enhancement

Research Agency:	University of Arizona	Program Date:	10/01/05
Principal Investigator(s):	Dr. Pitu Mirchandani	JPA Date:	Pending
Contract Amount (SPR):	Pending	Original Completion Date:	Pending
Project Budget:	$200,000	Estimated Completion Date:	(18 months)
Expenditures to date:	$0	Is project on schedule?	N/A
Available Amount:	$200,000	TRACS No.:	R0604 18P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	Steve Owen

PROBLEM STATEMENT

ADOT's Freeway Management System is designed for "smart" ramp metering, considering the impacts on mainline traffic flow, but real-time traffic-adaptive metering has never yet been deployed. New FMS upgrades will allow full utilization of control strategies, such as University of Arizona's MILOS program, to smooth traffic flows and improve regional operations. Phase 1, the current SPR 595 research, is the "proof of concept" for integration of existing ADOT systems with new traffic management programs and firmware, so that the optimum metering rates, as determined by MILOS, can be downloaded to the ramps.

This new Phase 2 project will implement MILOS, evaluate its operation, and identify required operational enhancements. It will deploy MILOS as an operational prototype system that can be field tested by ADOT operations staff to more efficiently manage freeway corridor operations.

RESEARCH OBJECTIVES

The new Phase 2 effort will evaluate the performance of MILOS in field operational conditions. Initially, MILOS will be operated in "shadow mode" to observe functionality, and to identify strengths and weaknesses as well as any needed enhancements. Solutions will be developed to address needs and deficiencies, tested using simulation, and implemented in the operational system. The program will then be run on-line to develop data to compare and evaluate both the "MILOS-ON" and "MILOS-OFF" performance.

EXPECTED IMPLEMENTATION:

This research, for the first time, would fully utilize technologies and capabilities that are already available in the existing ADOT ramp metering system, which is available for "smart" ramp metering, but was never configured to do so. A new traffic-adaptive ramp metering system will be incorporated into ADOT's FMS operations.

Implementation could begin to occur within two years on a corridor-priority basis. Significant benefits to the regional freeway system would include a decreased congestion and increased throughput on freeway networks, as well as improved efficiency and safety, reductions in resource consumption, and improved air quality.

STATUS OF THE RESEARCH

This project has not yet been initiated.

Intelligent Transportation Systems (ITS)

TECHNICAL ADVISORY COMMITTEE (TAC)

Tim Wolfe	Transportation Technology Group (Champion)
Manny Agah	Transportation Technology Group – TOC Manager
Darrell Bingham, Glenn Jonas, Lydia Warnick, and Jerry Pfeifer	Transportation Technology Group – TOC
Tom Parlante	Traffic Engineering Group
Joe McGuirk, Sonny Sollano	Phoenix Maintenance District
Sarath Joshua	Maricopa Association of Governments (MAG)
Dave Wolfson	Maricopa County DOT
Jim Decker, Christine Warren	City of Tempe
Ron Doubek	City of Phoenix
Brian Scifers, Ben McCawley	City of Chandler
Alan Hansen	Federal Highway Administration

Project 371, FY 1995

Maintenance Cost Effectiveness Study

Research Agency:	Applied Pavement Technology	Program Date:	07/01/94
Principal Investigator(s):	David Peshkin	Contract Date:	August, 2005
Contract Amount:	$15,000	Original Completion Date:	09/30/02
Program Budget:	$238,945	Estimated Completion Date:	November, 2005
Expenditures to date:	$191,341	Is project on schedule?	Yes
Available Amount	$47,604	Advantage No.:	R037113P
Percent complete through 06/30/05	50%	Responsible ATRC Staff: (Project Manager)	Yongqi Li

PROBLEM STATEMENT

The Strategic Highway Research Program (SHRP) investigated the cost effectiveness of several pavement surface treatment alternatives. However, the resulting data and analysis have not provided needed techniques and information for developing and promoting cost-effective pavement maintenance strategies.

The effectiveness of many maintenance activities such as pothole repair, crack sealing, flushing, surface treatments, etc., vary from area to area and their performance is difficult to quantify at a network or project level. In addition, considerable use of asphalt rubber is occurring by the Arizona Department of Transportation (ADOT). The preventive maintenance activities such as flushing, patching, etc. could be significantly different for these roadways. ADOT needs to establish procedures for the effective treatment of these products.

Many proprietary products have potential for providing cost-effective maintenance treatments. However, low-bid procurement processes often inhibit the use of these products due to the lack of information available to develop justifications based on “public interest." Additionally, innovative contracting procedures such as warranted work are currently difficult to implement. Evaluation of the current laws and procurement procedures are necessary to determine how some of these other alternative procurement processes can be utilized.

RESEARCH OBJECTIVES

The objectives of this project are to: (1) identify the maintenance surface treatment alternatives suitable for evaluation by ADOT, (2) develop a consensus on which alternatives to test, (3) determine the performance and cost effectiveness of these treatments, and (4) identify procurement issues which inhibit effective pavement maintenance and recommend solutions to these issues. This will be accomplished by developing an experimental design and constructing and evaluating test sections.

At a minimum, the following tasks will be accomplished:

1. Meet with the project TAC to review the scope of work and work plan.
2. Review on-going research activities such as ADOT’s work, Federal Highway Administration (FHWA) Long Term Pavement Performance (LTPP) program, Texas SMERP program, innovative contracting procedures, etc.

3. Canvas ADOT maintenance organizations for current pavement surface maintenance procedures and needs. Prepare a working paper describing these efforts. The working paper should clearly identify the research needs and the recommended treatments for evaluation.
4. Develop a statistically based research plan that allows the determination of the cost-effectiveness of the pavement surface maintenance strategies. The plan will include all the required testing, including quality control testing, performance criteria and evaluation plans and procedures.
5. Prepare a working paper that documents the procurement issues and recommends solutions. Issues such as warranty contracts, etc. will be evaluated in view of Arizona's procurement laws and procedures.
6. Document the construction activities of each of the sections and provide the sampling and testing specified in the experimental plan.
7. Monitor and evaluate the test sections for a minimum of five years.
8. Prepare annual reports and Research Notes documenting the performance to date of the test sections.
9. Prepare a final report, which determines the cost effectiveness of the various maintenance strategies and recommends specific alternatives for the appropriate maintenance areas.
10. Prepare a final report and Research Note of the literature review, research methodology, findings, conclusions, and recommendations.
11. Make an executive presentation to the Research Council at the conclusion of the Project.

EXPECTED IMPLEMENTATION

The project will provide life cycle surface treatment comparisons that can be used to select maintenance strategies and for cost effective surface treatments for new construction.

STATUS OF THE RESEARCH

One hundred ninety three test sections have been constructed. An additional 84 test sections were to be constructed in the fall of 2002 but the construction project was cancelled. The project is being conducted in three phases: Phase I Wearing Course Experiment; Phase II Surface Treatment Experiment; and Phase III Sealer Rejuvenator Experiment. Phase I and II is complete. A consultant has been retained to conduct an assessment on the results of Phase I and II and to make recommendations on Phase III. Phase III, which is being conducted in conjunction with the FHWA National Sealer/Rejuvenator project, will have a total of 60 –70 test sections placed in addition to the 193test sections constructed in support of phase I and II. The participating states are AZ, AL, CA, MN, and MI. Phase III test sections have been placed on SR 87 near Winslow and a second set will be place on US 93 near Nothing, Arizona. The second round of sealer-rejuvenator applications will occur in July-September.

TECHNICAL ADVISORY COMMITTEE (TAC)

Doug Forstie	State Engineer's Office	Yongqi Li	ATRC
Lonnie Hendrix	Central Maintenance	Roy A. Alvis	Prescott District
MSLT	Statewide	Jim Delton	Materials Group

Project 459, FY 1997

An Environmentally Acceptable Cold Mix for Statewide Use

Research Agency:	Pending	Program Date:	07/01/96
Principal Investigator(s):	Pending	Contract Date:	NA
Contract Amount:	NA	Original Completion Date:	NA
Program Budget:	$124,814	Estimated Completion Date:	NA
Expenditures to date:	$10,512	Is project on schedule?	No
Available Amount	$114,302	Advantage No.:	R045911P
Percent complete through 06/30/05	80%	Responsible ATRC Staff: (Project Manager)	Yongqi Li

PROBLEM STATEMENT

In the rural areas MC-250 is the product of choice for filling potholes, fixing road base failures, and providing level-ups. Often times MC-250 is mixed with locally available aggregate on road tables and blended at the maintenance yard. It is then stockpiled for up to six months to a year and used as needed. At other locations, the MC-250 is obtained from commercial sources and stockpiled for future use. MC-250 cold mix is very inexpensive when compared to other types of paving and patching materials.

Commercially available alternatives to MC-250 are typically significantly more expensive (perhaps three to four times more expensive), or they did not have an adequate shelf life to remain in storage for a minimum of six months.

MC-250 contains volatiles that exceed the air quality standards for Volatile Organic Compounds (VOC) and is no longer used in the active enforcement areas. Although still permissible in some areas, it will eventually not be an option.

There is a need to find an alternative material(s) for MC-250 or alternative ways of doing business. For example it may be possible to obtain commercial materials so that there is not a need to stockpile for any more than two to three months. This might make it possible to use other materials that are not now considered acceptable. Similarly other techniques for leveling may be considered

RESEARCH OBJECTIVES

The objectives of this research are to establish products and or processes that can replace MC-250 for its intended functions.

The minimum following tasks will be performed:

1. Canvass Arizona Department of Transportation (ADOT) maintenance organizations for an understanding of just how MC-250 is currently being used.
2. Conduct a search for available alternative materials and processes.
3. Canvass other agencies for their solutions to this problem.
4. Canvass locally available commercial sources for their ability to provide acceptable alternative products.

5. Develop a list of recommended products/and or process changes for evaluation by ADOT under field test conditions.
6. Conduct trial tests in at least three different maintenance orgs for suitability and performance for six months.
7. Prepare a final report documenting the efforts of the study and the conclusions and recommendations.
8. Prepare a Research Note in accordance with Arizona Transportation Research Center (ATRC) procedures.
9. Conduct an executive presentation to the Research Council.

EXPECTED IMPLEMENTATION

The products and or processes recommended in this study will be used to replace MC-250 for all of its current uses.

STATUS OF THE RESEARCH

New Mix Design procedures, based on the Asphalt Institutes MS-14 methodology, were implemented for the 2004 cold mix procurement. Field evaluations of the cold mix production are on going.

TECHNICAL ADVISORY COMMITTEE (TAC)

Danny Russell	Flagstaff District
Lonnie Hendrix	Central Maintenance
Doug Forstie	State Engineer's Office
Jim Delton	Materials Group
Yongqi Li	ATRC

Maintenance

Project 500, FY 2000

Aggregate Sources for Construction and Maintenance in Northern Arizona

Research Agency:	Pending	Program Date:	07/01/99
Principal Investigator(s):	Pending	Contract Date:	NA
Contract Amount:	Pending	Original Completion Date:	NA
Program Budget:	$250,000	Estimated Completion Date:	NA
Expenditures to date:	0	Is project on schedule?	No
Available Amount	$250,000	Advantage No.:	R050012P
Percent complete through 06/30/05	0%	Responsible ATRC Staff: (Project Manager)	Yongqi Li

PROBLEM STATEMENT

For the greater part of the interstate construction program, the Arizona Department of Transportation (ADOT) maintained the responsibility to locate acceptable aggregate sources for construction purposes. ADOT would locate sources of material, obtain all clearances and permits and perform the geotechnical analysis of the pit composition. At one time, ADOT maintained a database of over 8,000 material pits located around the state. This process made ADOT liable for material acceptability and often times resulted in claims from the contracting industry based upon misrepresentation of the character or quantity of material involved.

In more recent times ADOT turned over the material source issue to the contracting sector. The contractor currently is responsible for locating and obtaining pits for each individual construction project. This makes the contractor entirely responsible for his quality and quantity of material obtained.

Recently, material sources are becoming increasingly more difficult to find and use, even for the private sector. Many of the material sources in northern Arizona are located within reservations and the Indian nations have been less willing to allow access and use.

The lack of material availability is even affecting aggregate sources for maintenance use. There is a need to provide reliable aggregate sources for construction and maintenance activities.

RESEARCH OBJECTIVES

The objective of this research is to identify the aggregate sources available for construction and maintenance in northern Arizona and to determine the means by which these sources will be used.

The following minimum tasks will be performed:

1. Conduct a literature search relevant to available aggregate sources in Arizona.
2. Canvass the construction industry and other governmental agencies to establish additional pit sources and potential options for providing aggregate sources such as regionally located designated sources and or designated locations where materials are transported to or where large aggregate crushing contracts are established to provide material sources for many projects.

3. Canvass ADOT construction and maintenance personnel for problem identification and potential solutions.
4. Determine the locations/potential locations of all available material sources in northern Arizona for use by the highway community.
5. Prepare a working paper summarizing the recommendations for providing aggregate sources for construction and maintenance purposes in northern Arizona for the next ten years. The working paper will provide all the justification and supplemental information necessary to support the recommendations.
6. Upon approval of the recommendations submitted in Task 5, develop an implementation plan that will provide the material sources necessary for construction and maintenance operations in northern Arizona for the next ten years. The plan will specify each location, the plan for developing the site(s) and any process changes necessary to use the sources.
7. Prepare a final report documenting the efforts of the study and the conclusions and recommendations.
8. Prepare a Research Note in accordance with Arizona Transportation Research Center (ATRC) procedures.
9. Conduct an executive presentation to the Research Council.

EXPECTED IMPLEMENTATION

The results from this research project will establish the aggregate sources for construction and maintenance activities in Northern Arizona.

STATUS OF THE RESEARCH

This project will be piggybacked upon a previous effort by the state land department. Efforts are underway to form a new TAC and begin prosecution of the project.

TECHNICAL ADVISORY COMMITTEE (TAC)

Doug Forstie	State Engineers Office
John Lawson	Materials Group
Randy Vuletich	Materials Group
Allan Samuels	Construction Section
Jim Delton	Materials Group
David Sikes	Holbrook District
Chad Auker	Flagstaff District
Garry Slusher	Arizona State Land Department
Yongqi Li	ATRC

Project 520, FY 2001

Maintenance Repair Procedures for Bridge Decks

Research Agency:	Applied Pavement Tech.	Program Date:	07/01/00
Principal Investigator(s):	David Peshkin	Contract Date:	July, 2001
Contract Amount:	$30,000	Original Completion Date:	
Program Budget:	$30,000	Estimated Completion Date:	11/30/05
Expenditures to date:	$22,375	Is project on schedule?	Yes
Available Amount	$7,625	Advantage No.:	R052013P
Percent complete through 06/30/05	80%	Responsible ATRC Staff: (Project Manager)	Yongqi Li

PROBLEM STATEMENT

A significant number of the Arizona Department of Transportation (ADOT) bridges are twenty years and older. As these bridges age they deteriorate as a result of load related damage and from environmental damage such as freeze thaw action, sulfate attack, ASR activity, de-icing chemicals, etc.

Although the behavior of these environmental stresses is well documented, the detection and mitigation are difficult at best. It oftentimes requires sophisticated equipment and special materials.

Normal maintenance activities usually do not include repair to structures. However, as ADOT's aging structures become older and older repairs become more and more common. There is a need to provide both training and procedures for repairing bridge decks.

RESEARCH OBJECTIVES

The objective of this research project is to develop procedures and training materials for repair of bridge decks by maintenance forces.

The minimum following tasks will be performed:

1. Review the types of conditions (i.e., distresses) that are occurring on ADOT bridges. (ADOT has recently conducted a field evaluation of its bridge decks and this information is available).
2. Develop procedures for repairing bridge deck distresses for use by maintenance personnel.
3. Develop a one-day workshop on bridge deck repair.
4. Develop a tutorial for bridge deck repair that is web based and includes photos with instructions and examples.

EXPECTED IMPLEMENTATION

The results of this research would be used in working practice by ADOT's maintenance personnel.

Maintenance

STATUS OF THE RESEARCH

The project has been re-scoped to develop a bridge preservation program process that includes, among other things, repair procedures. The project will identify the items to be considered in the preservation program, and develop specifications for each of the preservation work items to be contracted out. The bridge group, materials, and central maintenance are collaborating together to develop the work items, specifications, and contracting procedures.

TECHNICAL ADVISORY COMMITTEE (TAC)

Jean Nehme	Bridge Group
Joel Miller	Globe District
Lonnie Hendrix	Central Maintenance
Yongqi Li	ATRC
Oscar Mousavi	Materials Section

Project 533, FY 2002

Development of Materials for Repairing AR-ACFC Surfaces

Research Agency:	Pending	Program Date:	10/01/2001
Principal Investigator(s):	Pending	Contract Date:	NA
Contract Amount:	Pending	Original Completion Date:	NA
Program Budget:	$0	Estimated Completion Date:	NA
Expenditures to date:	$0	Is project on schedule?	No
Available Amount	$0	Advantage No.:	R053314P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	Yongqi Li

PROBLEM STATEMENT

The Arizona Department of Transportation (ADOT) has traditionally placed an open-graded Asphalt Concrete Friction Course (ACFC) on all interstate and high volume roadways. Over the last ten years the department has changed from predominantly using ACFCs to using Asphalt-Rubber/Asphalt-Concrete Friction Courses (AR-ACFCs). These materials are installed as the final roadway surface and are what vehicle tires contact. These open graded materials are somewhat porous and are designed to drain the roadway surface quicker. As a result, they provide better wet-weather friction, better stripe delineation and produce less glare from headlights during inclement weather. They are also generally quieter than conventional dense graded mixtures.

Since these materials are somewhat porous, they cannot be repaired using conventional hot mix or cold mix materials that are typically non-porous. When non-porous materials are used, they behave as a dam within the AR-ACFC, trapping water and accelerating its deterioration. Currently there is no readily available material to repair AR-ACFC surfaces effectively. There is a need to develop and evaluate materials suitable for repairing AR-ACFC surfaces.

ADOT currently has an ongoing research project, SPR 459, to develop Environmentally Acceptable Materials as a Substitute for Cold Mix. The asphalt binders studied in this effort can be used for application to the open graded materials. However, there is a need to evaluate whether their performance will be acceptable.

RESEARCH OBJECTIVES

The objectives of this task are to develop/find materials for repairing AR-ACFCs and ACFCs and evaluate their acceptability for maintenance repairs.

The following tasks, at minimum, will be accomplished:

1. Review available materials for repairing open graded friction courses and compare to the products considered for use in SPR 459.
2. Produce repair materials and construct field test sections for evaluation.
3. Monitor the performance of the materials for three years.
4. Prepare a final report documenting the research methodologies, findings, and recommendations and conclusions.

5. Prepare an Arizona Transportation Research Center (ATRC) Research Note for distribution.
6. Prepare an executive presentation on the findings to the Research Council.

EXPECTED IMPLEMENTATION

If the research is successful, implementation would be immediate. The products developed in this research would be used by ADOT maintenance to repair open graded friction courses.

STATUS OF THE RESEARCH

This project will be developed concurrently with SPR 459. The scope of work will be revised accordingly.

TECHNICAL ADVISORY COMMITTEE (TAC)

Danny Russell	Flagstaff District
Lonnie Hendrix	Central Maintenance
Doug Forstie	State Engineer's Office
Jim Delton	Materials Group
Yongqi Li	ATRC

Project 536, FY 2002

Improved Snow Plow Headlight Visibility and Reduced Driver Fatigue

Research Agency:	Pending	Program Date:	10/01/2001
Principal Investigator(s):	Pending	Contract Date:	NA
Contract Amount:	Pending	Original Completion Date:	NA
Program Budget:	$50,000	Estimated Completion Date:	NA
Expenditures to date:	$0	Is project on schedule?	No
Available Amount	$50,000	Advantage No.:	R053614P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	Yongqi Li

PROBLEM STATEMENT

Plowing snow is very difficult, but very necessary. Poor weather reduces visibility. This problem is further exacerbated by the need to mount headlights higher on the equipment so they shine over the plows. This often results in the plow lights being almost at the operators' eye level, which is the worst condition for reflecting light back into the snowplow driver's eyes, obscuring their vision even more. This headlight position also reduces visibility for on-coming traffic since the headlights are higher than normal. The additional colored beacon lights that are used on plows as warning devices also reflect off of the snow into the operator's eyes. Although these lights are mounted behind the driver, they still reflect off the snow and obscure vision. Other problems that exist during plowing operations are the visibility through the windshield due to fogging over and the effectiveness of the wipers themselves.

A recent informal survey was conducted at the last maintenance workshop. Of the 50 to 100 respondents, not one operator felt that snowplow visibility was adequate. This is an alarming statistic since clearing of the roadway is the most significant safety improvement the Arizona Department of Transportation (ADOT) can make for the traveling public.

In addition to the reduced vision caused by these problems, increased driver fatigue is experienced. Since plowing snow is such a difficult event, anything that contributes to additional fatigue should be minimized or eliminated.

This problem was the focus of a recently completed National Cooperative Highway Research Program (NCHRP) study that made recommendations for improvements. ADOT's previous study on Winter Storm Operations also made recommendations to improve plow operations. However, no recommendations to improve lighting configurations have been provided to eliminate the problems described.

RESEARCH OBJECTIVES

The objective of this research is to increase operator visibility and to reduce glare to on coming traffic during plowing operations.

The following tasks, at minimum, will be accomplished:

1. Review recommendations of previous research, other state's practices, and available equipment.

2. Recommend the necessary equipment and procedures to improve driver visibility and to reduce glare to on-coming traffic. The recommendations should include costs.
3. Purchase the equipment and attachments necessary to retrofit one of ADOT's existing plows with the recommended equipment and demonstrate the visibility improvement through video documentation during inclement weather.
4. Document improvements to worker safety as a result of the installed devices/modified practices. The evaluations should be a before and after study
5. Prepare a final report documenting the research methodologies, findings, and recommendations and conclusions.
6. Prepare an Arizona Transportation Research Center (ATRC) Research Note for distribution.
7. Prepare an executive presentation on the findings to the Research Council.

EXPECTED IMPLEMENTATION

The results of this research would be used to modify ADOT's snowplow fleet.

STATUS OF THE RESEARCH

A former ATRC staff conducted some preliminary work. A prototype light support system has been developed in-house to "boom" lights beyond the plow in front of the plow. The proof of concept work indicated significant advantages to the lighting approach. The durability of the lighting system was not acceptable however. Accelerometers were placed on the plow during dry pavement operation to measure the actual accelerations experienced. A modification to the light fixture attachment will be made for testing in the fall of 04. Since the former ATRC staff that had conducted the work left ADOT the TAC has decided to hire a consultant to continue the project.

TECHNICAL ADVISORY COMMITTEE (TAC)

Joel Miller	Globe District
Dean Murgiuc	Equipment Services
Danny Russel	Flagstaff Maintenance
Kent Link	Flagstaff Maintenance
Carl Eyrich	Flagstaff Equipment
Yongqi Li	ATRC

Project 607, FY 2006

Analysis of and Recommendations for Alleviating Roadway Surface Damage Caused by Snowplow Activity

Research Agency:	Pending	Program Date:	10/01/2006
Principal Investigator(s):	Pending	Contract Date:	NA
Contract Amount:	Pending	Original Completion Date:	NA
Program Budget:	$20,000	Estimated Completion Date:	NA
Expenditures to date:	$0	Is project on schedule?	
Available Amount	$20,000	Advantage No.:	R060718P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	Yongqi Li

PROBLEM STATEMENT

There has been an increasing concern about damage to pavement surfaces and pavement markings caused by the operation of snowplows, particularly asphalt-rubber friction course (ARFC) surfaces. The Arizona Department of Transportation (ADOT) utilizes plow blades with Carbide-tipped snowplow bits and has transitioned from an abrasive based approach to a chemical based program of winter storm maintenance. This change has resulted in the plow blades being in contact with the asphalt surface rather than an "ice floor" that existed when abrasives were utilized. This change is a likely contributor to increased damage and wear of asphalt surfaces and pavement markings. An analysis of the mechanisms involved in surface damage and alternatives to reduce the damage are needed.

RESEARCH OBJECTIVES

There already exits extensive information regarding this topic, either in documented form or as undocumented experience and practice. The project objectives are to: (1) locate and assemble documented information; (2) conduct a survey among states and Canada to learn what practice has been used for solving or alleviating the problems; (3) identify all ongoing research; (4) learn what problems remain largely unsolved; (5) recommended practices for solving or alleviating the problem facing ADOT; (6) organize, evaluate, and document the useful information that is acquired; and (7) prepares concise, documented reports on the topic.

EXPECTED IMPLEMENTATION

Districts implement it during highway winter maintenance.

STATUS OF THE RESEARCH

Project is not yet underway.

TECHNICAL ADVISORY COMMITTEE (TAC)

Walter K. Link	Champion
Yongqi Li	ATRC

Project 396, FY 1995

LTPP and Other Test Section Management and Evaluation

Research Agency:	Arizona Transportation Research Center	Program Date:	07/01/92
Principal Investigator(s):	Larry Scofield, *et al*	Contract Date:	Pending
Contract Amount:	N/A	Original Completion Date:	N/A
Program Budget:	$143,373	Estimated Completion Date:	06/30/09
Expenditures to date:	$95,755	Is project on schedule?	Yes
Available Amount	$47,618	Advantage No.:	R039611P
Percent complete through 06/30/05	60%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

This project has been re-scoped and represents a consolidation of what was previously SPR 388, 390, 391, 393, and 395. Instead of having multiple projects, the efforts have been consolidated into SPR 396, which previously was just for GPS testing and evaluation.

RESEARCH OBJECTIVES

The objective of this project is to ensure the maintenance and evaluation of the ongoing LTPP test sections.

At a minimum, the following tasks will be accomplished:

1. Maintain the signing and pavement markings on all test sections.
2. Conduct filming of distress on test sections, digitize imagery, and conduct analysis of images.
3. Conduct forensic investigations on analysis of test section performance.

EXPECTED IMPLEMENTATION

This project provides for data collection, evaluation, and analysis to support the LTPP program and ADOT's pavement preservation program.

STATUS OF THE RESEARCH

This is an on-going activity through out the life of each of the test sections. Evaluation reports on the SPS profiles, and the SPS-5 and SPS-6 experiments are underway by Nichols Consulting, Inc. Draft reports have been submitted for the SPS profiles and the SPS-6 experiment.

TECHNICAL ADVISORY COMMITTEE (TAC)

Not Assigned

Project 402, FY 1995

Development of Performance Related Specifications for Asphalt Pavements

Research Agency:	Arizona State University	Program Date:	07/92
Principal Investigator(s):	Dr. Mat Witczak	Contract Date:	Not Applicable
Contract Amount:	N/A	Original Completion Date:	Not Applicable
Program Budget:	$1,019,220	Estimated Completion Date:	9/30/05
Expenditures to date:	$994,574	Is project on schedule?	Yes
Available Amount	$24,646	Advantage No.:	R040213P
Percent complete through 06/30/05	90%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

The American Association of State Highway and Transportation Officials (AASHTO) is currently developing a new pavement structural design guide that will be available in draft form in 2000/2001. The new AASHTO pavement structural design guide will be a mechanistic based design procedure. This form of pavement design (i.e. mechanistic design) has not been used by the Arizona Department of Transportation (ADOT) previously. This type of design process is technically more challenging and requires a higher degree of knowledge on the pavement design engineer as well as a more sophisticated approach to materials testing and characterization.

At this same time, the Federal Highway Administration (FHWA) is attempting to complete the Strategic Highway Research Program asphaltic concrete (AC) mixture design process with additional ongoing research. This research will develop a simple performance test and provide models and advanced materials characterization tests.

Both of these studies will significantly alter the methods by, which AC structural design and mixture design will be performed. The principal investigator on both of the above referenced research projects is Dr. Matt Witczak a professor at Arizona State University (ASU). To prepare ADOT for implementation of the above referenced research, ADOT and ASU have developed a five-year strategic pavement research effort. The first year of this effort was funded with SPR 402 "Long Term Pavement Performance (LTPP) Superpave Implementation".

RESEARCH OBJECTIVES

The overall objective of this continuation project is to implement a methodology for performance related specifications for asphalt pavements in ADOT. The short-term objective is to leverage the ongoing research activities of AASHTO and the FHWA into Arizona design practice.

The minimum following tasks will be performed:

1. Initiate and develop a fully coordinated and integrated pavement research program and unit consisting of ASU and ADOT personnel to focus on the enhancement of technology and economic aspects related to pavement performance.
2. Integrate the results of the most recent national research work being conducted in the United States on mechanistic pavement design and performance modeling into ADOT practice.
3. Develop an improved asphalt mixture design system that will be based upon the most recent advances formulated by the new Superpave design procedures.

4. Develop an ADOT asphalt cement characterization database.
5. Develop an ADOT AC stiffness characterization database.
6. Develop an ADOT mixture permanent deformation characterization database.
7. Develop an ADOT fracture characterization database.
8. Develop an ADOT unbound materials permanent deformation database.
9. Develop an ADOT unbound materials module characterization database.
10. Implement the Integrated Climatic model using ADOT environmental conditions.
11. Implement the simple performance AC mixture test in ADOT

EXPECTED IMPLEMENTATION

This is research is designed as a five year program intended to fast forward the implementation of the 2002 AASHTO Pavement Design Guide. Implementation of various technologies will occur as the research validates that the technologies are appropriate for Arizona use and implementation into practice.

STATUS OF THE RESEARCH

The project is essentially complete. Awaiting delivery of the final report.

TECHNICAL ADVISORY COMMITTEE (TAC)

Don Green	United Metro
Doug Forstie	State Engineers Office
Paul Burge	Materials Group
Julie Nodes	Materials Group
Christ Dimitroplos	ATRC
Bob McGenis	Koch Materials

Project 460, FY 1997

Evaluation of Cold In-Place Recycle Methods

Research Agency:	Arizona Transportation Research Center	Program Date:	07/01/96
Principal Investigator(s):	Larry Scofield	Contract Date:	N/A
Contract Amount:	N/A	Original Completion Date:	07/01/06
Program Budget:	$55,000	Estimated Completion Date:	07/01/06
Expenditures to date:	$18,944	Is project on schedule?	Yes
Available Amount	$36,056	Advantage No.:	R0460009P
Percent complete through 06/30/05	95%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

The national trend away from new construction to preservation of the highway system is requiring highway agencies to seek alternative approaches to pavement preservation. One option, which has seen considerable increase in use is recycling. Although, pavement recycling has been reported to have been done as early as 1915, its principal use has been since the mid-1970s. Recycling consists of both hot and cold recycling which can both be done in place or off site.

Cold in-place recycling has seen ever-increasing use in recent times due to improvements in technology, longer performance records, and greater emphasis on quality control. Cold in-place recycling is generally referred to as full-depth or partial-depth recycling. Partial-depth recycling is more prevalent and generally consists of rehabilitating the top 2 to 4 inches of the pavement structure. Some agencies require the placement of an overlay or wearing surface on top of the cold recycled material while other agencies allow cold recycle as the final wearing surface.

Partial depth, cold in-place recycling is an attractive option for use in Arizona, particularly with the remote locations of many highways. Unfortunately, there is not a single, nationally recognized design procedure. Instead, many procedures have evolved based upon experience and varying design philosophies. Two major theories have been promoted for designing cold mix materials. The first is to consider the salvaged material as simply black aggregate with some hardened asphalt coating and to design an asphalt content to coat these particles. The second theory considers the asphalt present in the salvaged material as part of the future binder design. This approach evaluates the physical and chemical aspects of the salvaged binder and adds a rejuvenating agent to restore the reclaimed asphalt to its original condition as well as adding additional binder for coating of the aggregate. Recent efforts have indicated that perhaps the actual phenomenon is somewhere between these two theories.

Many different binders can be used in the cold mix process. Typically, binder contents range from 0.5% to 1.5% of emulsion for partial depth, cold in-place mixes. Medium setting and high-float emulsions and emulsified recycling agents are typically used. In recent times polymer modification of some of these binders has seen increased use. Different mix design procedures can result in the selection of different binder types as well as different binder contents. This aspect of the cold recycling process has led many states to develop their “own” design

philosophies and procedures. These efforts are generally based on considerable local field performance data.

In addition to the more traditional methods of producing cold in-place material where the binder is incorporated directly into the salvaged material and then mixed together, foamed asphalt has seen a renewed interest and use. Foamed asphalt is a technique where the asphalt is "foamed" by first combining hot asphalt binder with water. The foamed binder is then mixed with the salvaged material by methods similar to those used in other cold recycling methods.

Although Arizona was one of the first states to use foamed asphalt techniques in the early 1960's, it has seen little or no use since that time. With advances in foaming procedures and mix design techniques, this may be a very cost-effective strategy.

Although the Arizona Dept of Transportation (ADOT) has constructed several cold in-place recycled projects, only limited or no experience exists with some of the different binder types and construction techniques. Since cold in-place recycling potentially offers considerable economic advantages, additional research is necessary to establish the best techniques and binders for use in construction and to begin to establish the life cycle costs of these design strategies.

RESEARCH OBJECTIVES

The objective of this research is to evaluate the performance of test sections constructed using selected binder types and construction procedures. The test sections will be constructed to establish long-term pavement performance.

At a minimum, the following tasks will be accomplished:

1. Meet with the project Technical Advisory Committee to review the scope of work and work plan.
2. Canvass selected states for the mix design procedures, binder types, construction specifications, and performance histories for partial-depth, cold in-place recycling. Document the available binder types and construction techniques for consideration of test section construction.
3. Determine the geographic locations where the cold mix recycling may be a viable design strategy and determine the desired number of locations for test section construction.
4. Determine which binders and construction techniques will be evaluated.
5. Develop the experimental plan establishing the number of test sections, locations, and analysis procedures.
6. Prepare the plans and specifications for test section construction, including all necessary testing and field evaluation. Identify upcoming candidate construction projects for inclusion of test sections. Currently, the US60 project (i.e., Goldfield Road to District Boundary) has been identified as a candidate project.
7. Perform long-term pavement performance evaluation for ten years after construction.
8. Prepare a final report and Research Note of the literature review, research methodology, findings, conclusions, and recommendations.

9. Make an executive presentation to the Research Council at the conclusion of the Project.

EXPECTED IMPLEMENTATION

After three to five years of performance data, it is expected that the cost-effective design strategies and techniques will be incorporated into the pavement design process for strategy selection.

STATUS OF THE RESEARCH

Eight test sections were constructed on SR87 north of Holbrook. Plans are underway to saw beam specimens from the roadway and test them in fatigue for materials characterization. All the test sections are performing similarly to date. A review of the historical information available for all of ADOT's approximate 20 CIR projects was conducted by ARA to document their construction and to evaluate their performance. A draft final report has been submitted.

TECHNICAL ADVISORY COMMITTEE (TAC)

Christ Dimitroplos	ATRC
Doug Forstie	State Engineer's Office

Project 471, FY 1998

Specific Applications of Shotcrete to Enhance Rock Mass Stability

Research Agency:	Arizona State University	Program Date:	7/01/97
Principal Investigator(s):	Dr. Dennis Duffy	Contract Date:	10/22/97
Contract Amount:	$126,000	Original Completion Date:	7/30/00
Program Budget:	$126,000	Estimated Completion Date:	12/31/03
Expenditures to date:	$116,778	Is project on schedule?	No
Available Amount:	$9,222	Advantage No.:	R047110P
Percent complete through 6/30/05	70%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

Arizona is a mountainous state and many miles of the highway network pass through steep terrain, where rock slopes are adjacent to the highway. Rock falls of various dimensions occur and can cause damage to property and result in injury to people. The Arizona Department of Transportation (ADOT) has the responsibility to reduce the risks caused by these rock falls.

Rock slopes along highways in Arizona require a considerable amount of maintenance each year. These maintenance activities can be dangerous, costly, and not aesthetically pleasing in the national forests. A non-invasive, low-cost technique to reduce the risk from rock fall is needed.

RESEARCH OBJECTIVES

The objective of this research is to develop a non-invasive, low-cost rock slope stabilizing technique

EXPECTED IMPLEMENTATION

The results of this research will provide Shotcrete materials and placement techniques that will enable contractor and maintenance personnel to non-invasively stabilize rock masses. Another product of the research will be a rock slope evaluation procedure to be used to determine where these materials/techniques will be used effectively. This information will be provided in easily understood material along with some training information.

STATUS OF THE RESEARCH

Two interim reports were submitted and reviewed by the technical advisory committee, the first in July 1999 and the second in July 2001. Those two phases of the project are now completed. The second phase included a 2-year observation of stabilized rock masses for which no failures were observed. During the same observation period, 400 rock falls were recorded from adjacent non-stabilized rock, an affirmation of selective stabilization.

A final phase of this project was requested, and tentatively approved, to resolve the issue of performance in severe freeze-thaw areas – to be performed on US60 MP 236. This final phase, for a budget of $36,500, will also investigate the use of site mixed concrete and fluid enhancing techniques.

Materials and Construction

TECHNICAL ADVISORY COMMITTEE (TAC)

Aryan Lirange	Federal Highway Administration
Ron Blackstone	Materials Group
Terry Brennen	Tonto National Forest
Roger Davis	Superior Maintenance
Tom Foster	Prescott
Bruce Kay	Consultant
John Lawson	Materials Group

Project 491, FY 2000

Evaluate the Cost Benefit of Continued Pavement Preservation Design Strategies Versus Re-Construction

Research Agency:	ERES Consultants	Program Date:	07/01/99
Principal Investigator(s):	Kurt Smith	Contract Date:	Pending
Contract Amount:	$112,260	Original Completion Date:	Pending
Program Budget:	$112,260	Estimated Completion Date:	10/30/04
Expenditures to date:	$83,996	Is project on schedule?	Yes
Available Amount	$28,264	Advantage No.:	R049112P
Percent complete through 06/30/05	97%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

The continued preservation of the Arizona Department of Transportation's (ADOT) pavements becomes an ever-increasing issue as non-renewable resources such as mineral aggregate become more and more difficult to obtain. Historically, ADOT's design philosophies have resulted in strategies that consist primarily of mill and fill and overlay. These pavement strategies are designed for approximately a ten-year life, at which time, another similar treatment would be performed.

Proper design philosophies evaluate life cycle costs to select the best available design option. However, the life cycle cost consists of both the construction cost and the user cost incurred by the public through delay, etc. While construction costs are easily defined, user costs are very difficult to quantify and often times may actually exceed the actual cost of the facility being constructed. Since the user costs are not directly borne by the agency, it becomes somewhat of a philosophical discussion as to what user costs should be considered.

In recent times, mineral aggregate sources have become increasingly more difficult to obtain in Arizona. However, our current design philosophies and economics require needing new materials approximately every ten years.

There is a need to consider reconstruction of significant roadways so that they can obtain design lives, perhaps as many as thirty to forty years before rehabilitation or reconstruction.

RESEARCH OBJECTIVES

The objective of this research is to evaluate the best pavement design strategies available, considering the recently completed research project on pavement performance and the recently developed life cycle cost analysis model prepared by the Federal Highway Administration (FHWA).

The minimum following tasks will be performed:

1. Review the results of ADOT Research Project SPR 404 and the FHWA Demonstration Project 115.
2. Conduct a literature search.
3. Review the availability of material sources for future construction in Arizona.

4. Analyze the typical construction costs associated with each of the designs studied by SPR 404 project and for typical ADOT new or reconstruction projects
5. Define the descriptive statistics for both performance life and construction costs for each of the evaluated design strategies. These results will be used as input into the FHWA Life Cycle Cost Model.
6. Evaluate the best practices for considering when to consider user costs and how best to determine and apply them.
7. Prepare recommendations as to the most cost-effective design strategies for Arizona and the best model for selecting alternatives for use in Arizona.
8. Prepare a final report documenting the efforts of the study and the conclusions and recommendations.
9. Prepare a Research Note in accordance with Arizona Transportation Research Center (ATRC) procedures.
10. Conduct an executive presentation to the Research Council.

EXPECTED IMPLEMENTATION

The results from this study would be used by the pavement design group for selecting cost-effective design strategies.

STATUS OF THE RESEARCH

The project is essentially complete. A draft final report has been submitted and is awaiting review by the TAC.

TECHNICAL ADVISORY COMMITTEE (TAC)

Jeffrey Swan	Consultant
George Way	Retired
Doug Forstie	State Engineer's Office
Jim Delton	Materials Group
John Louis	Roadway Design Group
Christ Dimitroplos	ATRC

Project 518, FY 2001

Reducing the Development Cycle Time for Construction Process

Research Agency:	Dye Management Group	Program Date:	07/01/01
Principal Investigator(s):	David Rose	Contract Date:	1/16/02
Contract Amount:	$50,000	Original Completion Date:	12/16/02
Program Budget:	$85,000	Estimated Completion Date:	10/30/04
Expenditures to date:	$57,329	Is project on schedule?	No
Available Amount	$27,671	Advantage No.:	R051813P
Percent complete through 06/30/05	95%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

The planning and development of a single construction project involves many tasks and different agencies as well as a significant number of internal Arizona Department of Transportation (ADOT) organizations and individuals. This requires that all projects be scoped and planned well in advance so that right-of-way (R/W) and environmental clearance can be obtained and that sufficient time is available to test and design the facilities.

However, it often times takes as long as six to eight years from when the need for a particular project is first identified to when actual construction is underway. During this time, the infrastructure asset can deteriorate significantly and/or the problem being solved by the new project can become critical. There is a need to reduce the cycle time from when the need for a project is first identified until it is under construction. This will significantly improve our ability to respond to ever changing conditions and provide higher levels of service to our customers.

RESEARCH OBJECTIVES

The objective of this project is to identify the changes necessary to reduce cycle time in getting construction projects underway and to develop an implementation plan to accomplish these changes.

The minimum following tasks will be performed:

1. Identify the steps and processes used by ADOT to develop construction projects.
2. Benchmark typical process times for each step/process.
3. Interview ADOT personnel regarding these process/steps and identify needed improvements and barriers.
4. Canvass selected transportation agencies to assess their cycle time experiences.
5. Prepare an interim report that documents the findings of tasks one through four. The interim report will also recommend the needed areas of improvement and the recommended changes to the current process.
6. Prepare detailed implementation plans to accomplish the recommended process changes.
7. Prepare a final report documenting the efforts of the study and the conclusions and recommendations.

8. Prepare a Research Note in accordance with Arizona Transportation Research Center (ATRC) procedures.
9. Conduct an executive presentation to the Research Council.

EXPECTED IMPLEMENTATION

No implementation is currently expected.

STATUS OF THE RESEARCH

The project is essentially complete. A draft final report is pending.

TECHNICAL ADVISORY COMMITTEE (TAC)

Arnold Burnham	TPD
Steve Jimenez	Statewide Projects
Ginger Murdough	Partnering Section
Bryan Kinney	Pre-Design Section
Mary Viparina	Statewide Projects
Christ Dimitroplos	ATRC

Project 524, FY 2001

Development of Mix Design Procedures and End Product Specifications for Gap-Graded Asphalt-Rubber Asphalt Concrete

Research Agency:	MACTEC	Program Date:	07/01/00
Principal Investigator(s):	Annie Stonex	Contract Date:	Pending
Contract Amount:	$103,110	Original Completion Date:	N/A
Program Budget:	$175,000	Estimated Completion Date:	10/30/04
Expenditures to date:	$147,035	Is project on schedule?	Yes
Available Amount	$27,965	Advantage No.:	R052413P
Percent complete through 06/30/05	95%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

Traditionally, mix designs for gap-graded, asphalt-rubber, asphalt concrete (AR-AC) have been performed by the Arizona Department of Transportation (ADOT) staff using experience and judgment. Test criteria and specifications have not evolved to the point that mix design activities can be out-sourced. This results in significant reliance on personal judgment and experience. This also prevents standardization and proper performance evaluation.

ADOT currently uses recipe or method type specifications for AR-AC construction. The method specifications have evolved with time and represent the collective experience and knowledge of the agency. However, this experience is difficult to transfer and improve.

In the early 1990's, the Federal Highway Administration (FHWA) formed a pooled fund study to develop mix design procedures and specifications for asphalt-rubber asphalt concrete mixtures. Unfortunately, prior to completion, this study was terminated without producing these products. There is a need to standardize mix design procedures for AR-AC. This will allow outsourcing of the mix designs, standardization of the procedures, more contractor responsibility in achieving a quality product, and better performance measurements.

RESEARCH OBJECTIVES

The objective of this research is to develop mix design procedures for designing and specifying AR-AC mixtures in construction.

The minimum following tasks will be performed:

1. Review ADOT's Current AR-AC Mix Design Procedures and Recommend Improvements
2. Develop Procedures for Using the SHRP Gyratory Compaction/Design Method for AR-AC Mix Designs
3. Compare Results of a Minimum of Three Mixes (Representative of different aggregate sources) Using Each of the Two Design Methods for each of the binder types (i.e. Type 1 and Type 2).
4. Conduct a Workshop to Present the Findings of the Above Comparison to Industry, Accredited ADOT labs and ADOT for Comment and Discussion
5. Based on the Results of the Testing and the Comments from the Workshop, ADOT will Select the Preferred Mix Design Procedure

6. Using the Selected Mix Design Method, Conduct Round Robin Testing with a Minimum of Three ADOT Accredited Labs and the Central Materials Laboratory
7. Conduct a Workshop to Present the Findings of the Above Comparison to Industry, Accredited ADOT labs and ADOT for Comment and Discussion
8. Prepare a recommended Arizona Test Method for Conducting AR-AC Mix Design. The procedures should be prepared in accordance with the standard test method format used by ADOT.
9. Prepare a Final Report documenting the effort and summarizing the results, conclusions, and findings

Prepare a Research Note

EXPECTED IMPLEMENTATION

The project has revised the Arizona 816 specifications.

STATUS OF THE RESEARCH

Revised specifications have been prepared. Round robin testing with contractor and consultant laboratories is underway.

TECHNICAL ADVISORY COMMITTEE (TAC)

Larry Ilg	Materials Group
George Way	Retired
Julie Nodes	Materials Section
Bob McGenis	Koch Materials
Christ Dimitroplos	ATRC

Project 574, FY 2004

Use of NDT Equipment for Construction Quality Control Of Hot Mix Asphalt Pavements

Research Agency:	Pending	Program Date:	07/01/03
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	N/A
Program Budget:	$135,000	Estimated Completion Date:	N/A
Expenditures to date:	$12,713	Is project on schedule?	Yes
Available Amount	$122,287	Advantage No.:	R057416P
Percent complete through 06/30/03	0%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

The new AASTHO 2002 Pavement Design Guide will use a mechanistic-empirical design procedure. This is a completely new form of pavement design compared to previous AASHTO design procedures. Use of this type of approach requires knowledge regarding the modulus, thickness, and poisons ratio of each layer.

Unfortunately, the current construction specifications are not based on these engineering properties. To successfully implement any mechanistic pavement design procedure and to move towards performance-related specifications, it is essential to develop tools that can measure the modulus of each layer.

There is a need evaluate tools that measure modulus and can be combined with results from laboratory and field tests and quality control during construction. To attain a goal of performance related specifications it will be necessary to unify design methodologies to the construction quality control.

Currently there is seismic based equipment that can be readily used in the laboratory for determining the modulus during the mix design stage and then used in the field to measure the as-constructed pavement modulus. These tests can be performed in two to three minutes and are completely non-destructive. They do not requiring coring of the materials nor any special fabrication in the lab beyond what is normally done during the design procedure.

RESEARCH OBJECTIVES

The research objective is to develop a pilot program similar to what the Texas DOT is doing for evaluating the use of seismic equipment for construction quality control of hot mix asphalt concrete pavements.

EXPECTED IMPLEMENTATION

If successful, implementation would require purchasing equipment

STATUS OF THE RESEARCH

The project is not yet underway.

Materials and Construction

TECHNICAL ADVISORY COMMITTEE (TAC)

Materials Group, Industry, TXDOT Personnel

Project 575, FY 2004

Concrete Aggregate Durability Study

Research Agency:	Applied Pavement Technology	Program Date:	07/01/03
Principal Investigator(s):	David Peshkin	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	10/30/05
Program Budget:	$37,000	Estimated Completion Date:	10/30/05
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount	$37,000	Advantage No.:	R057516P
Percent complete through 06/30/05	0%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

The durability of concrete aggregate has long been a problem in the transportation community. In particular, Alkali-Silica Reactivity (ASR) and Sulfate attack have been the two predominant problems associated with long-term concrete durability. Although considered an issue in surrounding states, this has not been considered a serious problem for structures or bridges in Arizona. Unfortunately, these problems typically take many years to manifest themselves and once detected, corrective action is often times difficult to undertake. So prevention is the best solution.

ASR and sulfate attack, although different distress mechanisms, occur as a result of an interaction between the environment and the concrete. Both distresses cause expansion within the hardened concrete resulting in cracking of the concrete.

A recent study on a major airfield in Arizona determined that significant alkali-silica reaction had occurred in the 14-year old concrete pavement. This suggests that this may be more of a concern than previously believed. This, coupled with the fact that it is an issue in surrounding states with similar geological sources, suggests that this needs further research.

RESEARCH OBJECTIVES

The objective of this research would be to review the available knowledge regarding aggregate problems in Arizona and the surrounding states. The minimum following tasks would be performed:

- Conduct Literature Search
- Canvass the industry and agencies for published and unpublished experience
- Review specifications used in Arizona and surrounding states for mitigating the impact of ASR and Sulfate.
- Prepare a report documenting the findings of the previous tasks and identifying any needed specification changes to ADOT's current concrete specifications.

Materials and Construction

EXPECTED IMPLEMENTATION

The product of this effort would be a report detailing the available information on aggregate performance in Arizona and surrounding states.

STATUS OF THE RESEARCH

The project was just awarded.

TECHNICAL ADVISORY COMMITTEE (TAC)

Materials Group, Industry, Consultants

Project 577, FY 2004

Pavement Noise Study

Research Agency:		Program Date:	07/01/03
Principal Investigator(s):		Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	10/30/05
Program Budget:	$99,000 (FY2005) ($657,000 total)	Estimated Completion Date:	10/30/05
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount	$99,000	Advantage No.:	R057717P
Percent complete through 06/30/05	0%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

Historically, noise mitigation measures used in the U.S. transportation industry have included use of barriers, walls, and separation (e.g., distance). These methods have been the only acceptable solutions for federally funded projects. Quiet pavements can also be used to mitigate noise but are not currently permitted because the Federal Highway Administration (FHWA) does not view them as a permanent solution.

In Arizona, like other states, berms and walls are the primary noise mitigation measures in the urban corridors. In April 2003, ADOT received approval from FHWA to allow the use of pavement surface type as a noise mitigation strategy. This approval allowed the use of Asphalt Rubber Friction Course (ARFC) overlays as a noise mitigation strategy when used on existing and newly constructed concrete pavements. Where this surfacing is used, ADOT receives a four-decibel reduction for the design of walls and berms. This credit equates to a six to eight foot reduction in wall or barrier height. Perhaps a more meaningful analogy is that if just a three-decibel reduction were achieved through the use of a quiet pavement, it would have a noise impact of about half of the actual traffic volume.

The FHWA approval was granted with the condition that Arizona be a pilot program, with specific research objectives and requirements. The required research is intended to validate the efficacy of using ARFC as a noise mitigation strategy. Since the FHWA was concerned that a pavement solution is not a permanent solution, they requested a pilot program to study the long-term performance of the ARFC overlay. ADOT committed to a long-range study for up to 10 years, the estimated minimum life cycle of the ARFC pavement.

The ADOT Intermodal Transportation Division (ITD) is currently conducting studies of Type 2 (wayside noise measurement) sites. The ITD studies will complement this research, which focuses on Type 1 (source noise) and Type 3 (research grade) sites.

Materials and Construction

RESEARCH OBJECTIVES

The objective of the research is to measure and compare noise generated from different pavement types over time. The effects of pavement design and pavement age will be monitored as they affect noise generation from vehicle traffic.

EXPECTED IMPLEMENTATION

The results of the research will be used in the design of future road construction projects.

STATUS OF THE RESEARCH

A Joint Project Agreement (JPA) with the Arizona State University (ASU) Materials Group and a JPA with the ASU Environmental Group are complete. A JPA with the Federal Highway Administration Volpe Center is also complete.

TECHNICAL ADVISORY COMMITTEE (TAC)

A TAC is being developed.

Project 590, FY 2005

Performance Related Pay Factors for Asphalt Concrete

Research Agency:	Arizona State University	Program Date:	07/01/04
Principal Investigator(s):	Dr. Matt Witczak	Contract Date:	Pending
Contract Amount:		Original Completion Date:	Pending
Program Budget:	$50,000	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount	$50,000	Advantage No.:	R059017P
Percent complete through 06/30/05	0%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

Currently, ADOT accepts asphalt concrete production based on ten different quality factors. These include: sand equivalent, fractured coarse aggregate particles, uncompacted void content (special mix), material spread, gradation, asphalt cement content, effective voids, stability, compaction, and smoothness.

Of these ten, four are used to determine the mixture-properties and compaction pay factor. They are gradation, asphalt cement content, effective voids, and compaction. The mixture property and compaction pay factor is used to pay the contractor for each ton of asphalt produced on the project. The purpose of the mixture pay factor is to determine payment, based upon on the percent of product within a specified tolerance. This allows payment to be based upon mixture quality. That is, the higher the quality the higher resulting payment.

The mixture property and compaction pay factors were largely developed on experience and judgment and on production equipment capability. The linkage between these pay factors and pavement performance and pavement design is currently not known.

It would be very beneficial to have pay factors that are based upon actual pavement performance and design procedures. The recently completed NCHRP 2002 Pavement Analysis tool provides the capability to evaluate the effect of these mixture characteristics on pavement design and performance. Therefore, rational pay factors could be determined based upon actual design conditions and attendant pavement performance.

RESEARCH OBJECTIVES

The objective of this research is to develop new pay factors for inclusion into ADOT's specifications based upon analysis conducted using the NCHRP 2002 Pavement Analysis Tool. Sensitivity analysis will be conducted for each of the relevant mixture and compaction properties to determine their effect on pavement performance.

EXPECTED IMPLEMENTATION

The results of this research should be used to replace the pay factors shown in section 416 of the standard specifications.

Materials and Construction

STATUS OF THE RESEARCH

The project has not begun.

TECHNICAL ADVISORY COMMITTEE (TAC)

Materials Group,

Project 605, FY 2006

Investigations of Environmental Effects on Freeway Acoustics

Research Agency:	Arizona State University	Program Date:	10/01/06
Principal Investigator(s):		Contract Date:	Pending
Contract Amount:		Original Completion Date:	Pending
Program Budget:	$90,000	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount	$90,000	Advantage No.:	R060518P
Percent complete		Responsible ATRC Staff:	Christ
through 06/30/05	0%	(Project Manager)	Dimitroplos

PROBLEM STATEMENT

In April of 2003, ADOT received approval from the FHWA to allow the use of pavement surface type as a noise mitigation strategy. This was granted with the condition that Arizona would conduct a pilot program related to this strategy. A research program was developed to validate the efficacy of using Asphalt Rubber Friction Courses (ARFC) as a noise mitigation strategy. ADOT has begun to monitor four sites across the Phoenix Metropolitan area over a ten-year period to evaluate the effectiveness of ARFC. Recent experiences, however, suggest that traditional noise abatement approaches (e.g. the use of walls) can be defeated by environmental conditions. In the last year, researchers at Arizona State University helped ADOT to monitor environmental conditions associated with acoustic monitoring. In the first (completed) phase, the effects of winds on noise propagation were studied. However, the effects of inversions have not been studied, although they are known to be important; and this will be focus of the proposed work.

RESEARCH OBJECTIVES

In order to understand the influence of stability (inversion) conditions on sound propagation, we will conduct environmental monitoring, concurrent with ADOT acoustic monitoring, under different stability conditions -- during the night or early in the morning, before inversion breakup and during the afternoon during the unstable conditions. Detailed profiles of wind speed and temperature will be obtained using a SODAR (Sound Detection And Ranging) system and its RASS (Radio Acoustic Sounding System) extension. The SODAR remotely sense the wind speed and turbulence statistics profiles in the lower atmosphere (15-1000m). RASS provides the temperature and sound speed profiles (both instruments are available for the ASU group). If surface measurements are needed (< 15m), tethered balloons can be employed. The deliverables of the project are: (i) All temperature, velocity and humidity data in the required forms; (ii) Plots showing the effects of inversions on sound propagation – a manual of results; (iii) Analysis of results; (iv) Final report detailing the procedure, uncertainties, analysis, results and inferences.

EXPECTED IMPLEMENTATION

The results will be melded with ADOT sound monitoring data.

Materials and Construction

STATUS OF THE RESEARCH

The project has not begun.

TECHNICAL ADVISORY COMMITTEE (TAC)

Christ Dimitroplos (ATRC; M&C Project Manager; Champion); Larry Scofield (Private consultant); Tom Kombe (ATRC, Environmental Project Manager); Fred Garcia (ADOT, Environmental Group); Hugh Saurenman (ATS Consulting)

Project 606, FY 2006

Implementation of the Mechanistic-Empirical (M-E) Design Guide for Arizona

Research Agency:		Program Date:	10/01/06
Principal Investigator(s):		Contract Date:	Pending
Contract Amount:		Original Completion Date:	Pending
Program Budget:	$350,000	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount	$350,000	Advantage No.:	R060618P
Percent complete		Responsible ATRC Staff:	Christ
through 06/30/05	0%	(Project Manager)	Dimitroplos

PROBLEM STATEMENT

To complete the final phase of current Project SPR-402: Implementation of the Mechanistic-Empirical Design Guide for Arizona.

Task 1- Accurately calibrate the pavement performance models to local field conditions.

Task 2 - How to implement the Mechanistic-Empirical Design Guide for pavement design and performance prediction in Arizona.

Task 3- Develop a framework for performance related specifications for Arizona.

RESEARCH OBJECTIVES

To calibrate pavement performance models to local conditions using Arizona field data. The result will enable ADOT to utilize the M-E Design Guide and develop a framework for Pavement Performance related specifications.

EXPECTED IMPLEMENTATION

The overall assessment of the utility of the Mechanistic Empirical Design Guide calibrated for Arizona materials and conditions. Framework for pavement performance related specifications for Arizona.

STATUS OF THE RESEARCH

The project has not begun.

TECHNICAL ADVISORY COMMITTEE (TAC)

Jim Delton, Julie Nodes, Paul Burch, Bill Hurguy, ATRC, Private Industry.

Project 608, FY 2006

Development of Rational Pay Factors Based on Concrete Compressive Strength Data

Research Agency:		Program Date:	10/01/06
Principal Investigator(s):		Contract Date:	Pending
Contract Amount:		Original Completion Date:	Pending
Program Budget:	$14,000	Estimated Completion Date:	Pending
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount	$14,000	Advantage No.:	R060618P
Percent complete		Responsible ATRC Staff:	Christ
through 06/30/05	0%	(Project Manager)	Dimitroplos

PROBLEM STATEMENT

Concrete strength is one of the major parameters used in the acceptance of a concrete supplied to the Arizona Department of Transportation (ADOT). The purpose of this research project is to compile a set of guidelines used by various transportation agencies and the Federal Highway Administration (FHWA) with respect to acceptance criteria and the use of strength data in the determination of pay factors. The research team will evaluate the applicability of those procedures in consideration of current and proposed ADOT standards.

This document will address a variety of issues that may create the potential for testing cores vs. cast specimens, flexural samples, maturity, and inter-strength relationship between flexural and compressive strength established for the approved mix design (prior to construction) using project-approved aggregates, cement, and admixtures.

The research will focus on obtaining information related to these processes, as well as identifying the typical standard deviations associated with the different strength sampling methods. There are three major tasks identified:
Phase 1 – Evaluation of acceptance criteria
Phase 2 – Evaluation of penalty factors
Phase 3 – Applicability of the acceptance criteria and penalty factors for the use of High performance concrete and high fly ash mixtures.

RESEARCH OBJECTIVES

1. Conducting a state of the art report of what other states are using as a means of acceptance and pay factor determination using concrete property data.
2. Establishment of clear target values (means and standard deviations) that define the pavement quality for which the State Highway Agency is willing to pay 100 percent of the contractor bid price.
3. Provide a straightforward method for determining rational pay adjustments (incentives and disincentives) that are applied when a higher or lower level of quality (as compared to the chosen acceptance quality characteristics (AQC) target values).
4. Investigation of applicability of new software codes which, are used to make potential contractors fully aware of the pay adjustments prior to bidding a project. These include utilization PaveSpec 2.0 software to evaluate the consequences and risks of providing different levels of quality and the risks involved in sampling and testing.

5. Evaluation of the applicability of the test methods to concrete materials with properties different than the conventional concrete materials (i.e., high fly ash, high strength, permeability criteria, etc.)

EXPECTED IMPLEMENTATION

The research will result in information that could be used to improve the quality of concrete construction in the State of Arizona.

STATUS OF THE RESEARCH

The project has not begun.

TECHNICAL ADVISORY COMMITTEE (TAC)

Jim Delton - ADOT, Scott Weinland - ADOT, Chad Auker - ADOT, John Ivanov - ADOT, Robert Barkley – Hansen Materials, Pat Nealio – Lehigh Southwest Cement

Project 528, FY 2001

Cost of Damage Done to Arizona Highways by Overweight Vehicles

Research Agency:	ESRA	Program Date:	07/01/00
Principal Investigator(s):	Sandy Straus	Contract Date:	11/10/04
Contract Amount:	$9,399	Original Completion Date:	06/30/02
Program Budget:	$10,000	Estimated Completion Date:	12/31/05
Expenditures to date:	$2,649	Is project on schedule?	Yes
Available Amount:	$7,351	Advantage No.:	R052813P
Percent complete through 6/30/05	95%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

The Arizona Department of Transportation (ADOT) has primary responsibility for enforcing laws regulating size and weight of commercial and non-commercial vehicles on the state's highways. ADOT's Motor Vehicle Division (MVD) coordinates enforcement activities. It is contended that overweight vehicles are the primary cause of highways within this state failing to meet their expected or designed life spans. Overweight vehicle axles cause a damage factor to the fourth power to pavement and the infrastructure. This equates to millions of dollars in damage that must be funded from highway user taxes and other sources. These expenditures for avoidable maintenance reduce the capability and funding to build new highways and to maintain existing roads in a comprehensive manner. We need to identify and quantify that cost figure.

RESEARCH OBJECTIVES

1. Identify the various methods of quantifying pavement damage due to overweight vehicles.
2. Identify which one most represents conditions or activity in this state.
3. Identify remedial and enforcement options for dealing with overweight vehicles.

EXPECTED IMPLEMENTATION

The proposed research would promote effective enforcement of size and weight laws on Arizona highways. It would also give evidence of overspending or under spending for this activity. This would give valuable information to support efforts in weight enforcement, make planning for future highways more efficient, and provide budgetary directions or priorities for MVD.

STATUS OF THE RESEARCH

The project is nearing completion.

Planning and Administration

TECHNICAL ADVISORY COMMITTEE (TAC)

Steve Abney	Motor Vehicle Division
Ed Stillings	Federal Highway Administration
John Semmens	Arizona Transportation Research Center
Mark Catchpole	Transportation Planning Division
Jim Delton	Materials
Gary Orlich	MNDOT

Planning and Administration

Project 534, FY 2002

Digital Signatures

Research Agency:	Pending	Program Date:	10/01/01
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	12/31/02
Program Budget:	$85,000	Estimated Completion Date:	12/31/06
Expenditures to date:	$70,971	Is project on schedule?	No
Available	$14,029	Advantage No.:	R053414P
Percent complete through 6/30/05	60%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

The Arizona Department of Transportation (ADOT) wishes to do more electronic transactions (electronic bidding, procurement, other Motor Vehicle Division transactions, etc.). Many of these transactions require a signature in order to prove a particular person signed a document. Without an electronic means to prove that a particular person or business approved the transaction, these electronic transactions are not possible. This adversely affects the Arizona Department of Transportation by precluding these transactions from being done electronically.

Electronic commerce relies on secure communication between two or more trusting parties. Digital signatures are a necessary component for electronically completing certain transactions. With the volume of electronic commerce and business-to-business transactions skyrocketing, the acceptance of digital signatures is more a question of “when” rather than “if.”

But what exactly will a digital signature look like? While most people might imagine scribbling with little electronic pens on an interactive notepad, digital signatures will, for the foreseeable future, remain far more arcane – and not entirely intuitive. For now, a signature is likely to be a simple bit of encryption embedded in one’s own personal computer that tells other computers that a request for a commercial transaction over the Internet is coming from one’s computer.

Digital signatures ensure a higher level of security and privacy for electronic messages or transactions. Using encryption algorithms, the sender encodes and then "signs" his message, and the receiver can only decode and read it with a corresponding secret code, or "key." The signature lets the receiver know the message hasn't been tampered with or forged. Many observers feel that adoption of such schemes, coupled with strong encryption, is necessary for mass use of the Internet for electronic commerce.

RESEARCH OBJECTIVES

1. Prepare a comprehensive study of all the areas within ADOT that digital signatures would help it do business electronically.
2. Propose a technical architecture along with plans for a pilot implementation

EXPECTED IMPLEMENTATION

The estimated implementation cost for a full deployment will be determined by the research project. The Information Technology Group will be the ultimate process owner.

Planning and Administration

STATUS OF THE RESEARCH

The project is being re-bid.

TECHNICAL ADVISORY COMMITTEE (TAC)

David Moy
Tami Price
Jamie Rybarczyk
Rich Nacinovich
Joe Throckmorton
Vicki Tsutsumida Federal Highway Administration:
John Semmens Arizona Transportation Research Center:

Project 535, FY 2002

Commercial Vehicle Information Systems Network (CVISN) Safety Information Exchange Needs Assessment for the Nogales Port-of-Entry

Research Agency:	Arizona Transportation Research Center	Program Date:	10/01/01
Principal Investigator(s):	Robert Done	Contract Date:	11/03/04
Contract Amount:	$14,820	Original Completion Date:	12/31/05
Program Budget:	$385,000	Estimated Completion Date:	12/31/05
Expenditures to date:	$144,542	Is project on schedule?	Yes
Available Amount:	$240,458	Advantage No.:	R053514P
Percent complete through 6/30/05	100% (phase 1) 5% (phase 2)	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

Various federal and state motor carrier safety information systems are now available, but are not installed nor being used at the Nogales Cargo Port. This hampers the ability for all commercial vehicle safety inspectors to capture, communicate and collect data pertinent to vehicles and drivers they are examining. The inability of truck inspectors to have immediate access to required records may lead to potential accidents or allow problem drivers to operate vehicles.

The state and federal governments are developing a multi-million dollar inspection facility at Nogales. The lack of timely vehicle and driver information will have an impact on the facility operating at full potential.

A Commercial Vehicle Information Systems Network (CVISN) will provide Arizona and federal truck inspectors with an excellent means to use available technology to obtain and exchange driver and vehicle records, both with Mexican and US authorities, especially as they relate to Motor Carrier Safety and crash history. A Commercial Vehicle Information Systems Network is another smart technology enhancement that will make easier law enforcement's job of making highways safer for the motoring public and preserving the transportation infrastructure.

RESEARCH OBJECTIVE

Evaluate the specific needs in terms of a safety information exchange system under the umbrella of a Commercial Vehicle Information Systems Network and intelligent transportation systems related technologies.

EXPECTED IMPLEMENTATION

The research outcome will help identify how the Arizona Department of Transportation, along with the Department of Public Safety and U.S. Department of Transportation, can enhance their collective motor carrier safety objectives. These successful accomplishments will lead to safer vehicles, safer drivers and an overall safer highway transportation environment, with an attendant drop in highway crashes and a decrease in resultant injuries and fatalities. The Motor Vehicle Division of the Arizona Department of Transportation will be the process owner.

STATUS OF THE RESEARCH

The project is underway.

TECHNICAL ADVISORY COMMITTEE (TAC)

George N. Bays	Motor Vehicle Division:
Manny Agah and Marian Thompson	Traffic Operations Center:
Ronald Sandlin	GSA, Desert Service Center
Armando Goncalvez	US Customs & Border Protection
Ursula Miller	Dept of Public Safety
Ric Athey	MVD
Jennifer Brown and Ed Stillings	Federal Highway Administration:
John Semmens	Arizona Transportation Research Center:

Project 544, FY 2002

What is the Best Mix of Service Delivery Strategies that Can Be Employed to Reduce Customer Time in Motor Vehicle Division Field Offices?

Research Agency:	Arizona Transportation Research Center	Program Date:	10/01/00
Principal Investigator(s):	Pending	Contract Date:	08/30/02
Contract Amount:	Pending	Original Completion Date:	7/31/02
Program Budget:	$12,000	Estimated Completion Date:	12/31/06
Expenditures to date:	$0	Is project on schedule?	No
Available Amount:	$12,000	Advantage No.:	R054414P
Percent complete through 6/30/05	5%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

Registering a vehicle and obtaining a driver's license are among the major points of contact between the public and the Arizona Department of Transportation (ADOT). We want to be "customer friendly" and make these types of transactions as simple as possible. At the same time, ADOT must ensure that drivers are qualified and fees are paid.

To minimize cost and maximize customer satisfaction, transactions between customers and ADOT should be conducted as efficiently as possible. Some of these transactions can be conducted over the phone, by mail, or on the internet. Other transactions (new driver's licenses, for example) require that the customer come to a Motor Vehicle Division (MVD) field office to take a vision or on-the-road test. There are an array of options and strategies for conducting these various transactions.

The question is, which set of options or strategies would be optimal for meeting the needs of ADOT and its customers?

RESEARCH OBJECTIVES

1. Compile a comprehensive list of transaction methods that might be used by the Motor Vehicle Division.
2. Describe the advantages and disadvantages of each method.
3. Where feasible, estimate a cost/benefit profile for each method.

EXPECTED IMPLEMENTATION

The research will result in information that could be used to guide a more effective Motor Vehicle Division customer service program in Arizona. MVD will be the process owner.

STATUS OF THE RESEARCH

The project is on hold at MVD's request.

Planning and Administration

TECHNICAL ADVISORY COMMITTEE (TAC)

Charlene Knapp	Motor Vehicle Division
Terry Trost	Office of Strategic Planning and Budget
Karen King	Federal Highway Administration
John Semmens	Arizona Transportation Research Center Project Manager

Project 547, FY 2002

Arizona Statewide Safety Project Analysis Model

Research Agency:	Arizona Transportation Research Center	Program Date:	10/01/01
Principal Investigator(s):	Jason Carey	Contract Date:	08/30/02
Contract Amount:	$10,500	Original Completion Date:	7/31/03
Program Budget:	$12,000	Estimated Completion Date:	12/31/05
Expenditures to date:	$709	Is project on schedule?	Yes
Available Amount:	$11,291	Advantage No.:	R054714P
Percent complete through 6/30/05	20%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

In June 2001, the Arizona Transportation Research Center (ATRC) completed a research project in which a model was developed for evaluating prospective safety projects on local government streets and roadways. This model enables the user to identify high crash locations based on total crashes, fatalities, and aggregate cost of crashes. Further, the model then permits the user to compare benefit/cost ratios for prospective safety improvements. The result is a tool that assists local governments in selecting the most cost-effective means for remedying the worst crash locations.

This proposed project would adapt the previously developed model to include State Highways in the database. This would enable a more comprehensive safety analysis of all roadways in Arizona. Users of the model would be able to identify and propose remedies for the worst crash sites regardless of the jurisdiction controlling the sites. Safety project investments could be optimized across jurisdictional boundaries and drivers in Arizona would enjoy the maximum pay-off in terms of reduced crash costs per dollar of investment no matter where they travel in the state.

RESEARCH OBJECTIVES

1. The existing database model will be enhanced to accommodate a statewide, multi-jurisdictional perspective.

EXPECTED IMPLEMENTATION

The research will result in a report and model that can be used by state and local governments to more effectively evaluate potential safety projects. The process owner would be the Transportation Planning Division, ADOT.

STATUS OF THE RESEARCH

The project has been on hold pending input from SPR 550.

Planning and Administration

TECHNICAL ADVISORY COMMITTEE (TAC)

Dale Buskirk	Transportation Planning Division
Richard Fimbres	Governor's Traffic Safety Advisory Council
Sarath Joshua	Maricopa Association of Governments
George Wendt	ADOT Risk Management
Jennifer Brown	Federal Highway Administration
John Semmens	Arizona Transportation Research Center Project Manager:

Project 550, FY 2002

The Impact of Automated Traffic Law Enforcement on Crash Rates

Research Agency:	Arizona Transportation Research Center	Program Date:	10/01/01
Principal Investigator(s):	Simon Washington	Contract Date:	10/21/02
Contract Amount:	$12,000	Original Completion Date:	12/31/03
Program Budget:	$12,000	Estimated Completion Date:	08/31/05
Expenditures to date:	$9,720	Is project on schedule?	Yes
Available Amount:	$2,280	Advantage No.:	R055014P
Percent complete through 6/30/05	95%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

Red light cameras and photo-radar are widely used automated traffic law enforcement devices. Would expanding their use even further be a cost-effective way to increase roadway safety? Or are there other more, simple and less costly ways of reducing crashes? For example, it has been suggested that increasing the yellow-phase on traffic signals would be an effective way t

o reduce red-light crashes.

What is needed is a comprehensive survey of results as measured by before-and-after traffic crash rates for areas that use these devices vs. areas that do not. One or more other simple measures for decreasing crash rates will be examined for comparative purposes. Such research would give state and local governments a sound foundation for investing funds in ways that would efficiently improve roadway safety.

RESEARCH OBJECTIVES

1. Estimate the impact of red-light cameras and photo-radar on traffic crash rates.

2. Compare these estimates with one or more simpler alternative measures.

EXPECTED IMPLEMENTATION

The research will result in information that could be used to assess the effectiveness of automated enforcement options. The Governor's Traffic Safety Advisory Council will be the process owner.

STATUS OF THE RESEARCH

The project is nearing completion.

Planning and Administration

TECHNICAL ADVISORY COMMITTEE (TAC)

Richard Fimbres	Governor's Traffic Safety Advisory Council
Steve Bacs	National Motorist Association
George Wendt	ADOT Risk Management
Sarath Joshua	Maricopa Association of Governments
Jennifer Brown	Federal Highway Administration
John Semmens	Arizona Transportation Research Center Project Manager

Planning and Administration

Project 559, FY 2003

Comprehensive Automated Driver's License Testing System: The Visual Acuity Test

Research Agency:	Phase 2 Pending	Program Date:	10/01/03
Principal Investigator(s):	Phase 2 Pending	Contract Date:	Phase 2 Pending
Contract Amount:	Phase 2 Pending	Original Completion Date:	Phase 2 Pending
Program Budget:	$100,000	Estimated Completion Date:	Phase 2 Pending
Expenditures to date:	$14,138	Is project on schedule?	Yes
Available Amount:	$85,862	Advantage No.:	R055915P
Percent complete	Phase 1 100%	Responsible ATRC Staff:	
through 6/30/04	Phase 2 0%	(Project Manager)	John Semmens

PROBLEM STATEMENT

With the advent of an aging population in Arizona, the need for a Comprehensive Automated Vision Testing program is increasing. The current process within the Motor Vehicle Division (MVD) is lacking in identifying vision deficient drivers. The increased traffic volumes present multiple challenges to all Drivers, but especially those with a vision deficiency. The lack of a Glare Recovery component, a Depth Perception Component and a good Peripheral Vision Component, leaves many Arizona drivers unprepared for the challenges of driving. Vision is 80% of the driving task, it is imperative that Arizona investigate new technology in this Area. With the expanded time frames between required re-testing, compounds the need for a better Screening process. Sign recognition, traffic signal identification, increasing traffic volumes and Traffic congestion all play an important part in the driving process. A vision deficient driver may be operating under the assumption that they are OK, because they have an Arizona Drivers License.

RESEARCH OBJECTIVES

1. Identify cutting edge technology in the area.
2. Propose improved / new technology for testing.
3. Test and evaluate new technology.
4. Prepare and publish report of evaluation.

EXPECTED IMPLEMENTATION

The Arizona Department of Transportation (ADOT) will conduct the research in two phases: (1) a pre-installation review of options and (2) a post-installation test of the chosen option. MVD will carry out the ultimate implementation if the recommendation of the research calls for it.

The estimated implementation cost for a full deployment will be determined by the research project. MVD will be the ultimate process owner.

Planning and Administration

STATUS OF THE RESEARCH

The project is nearing completion.

TECHNICAL ADVISORY COMMITTEE (TAC)

Richard Schweinsburg	Motor Vehicle Division
Kathy Medoff	Motor Vehicle Division
Robert Hall	Motor Vehicle Division
George Wendt	Risk Management
Sharon Gordon	Federal Highway Administration
John Semmens	Arizona Transportation Research Center Project Manager

Planning and Administration

Project 578, FY 2004

Evaluating and Improving the Dyed Diesel Education and Enforcement Program

Research Agency:	Data Methods	Program Date:	10/01/04
Principal Investigator(s):	Robert Done	Contract Date:	08/11/04
Contract Amount:	$14,820	Original Completion Date:	12/31/05
Program Budget:	$15,000	Estimated Completion Date:	12/31/05
Expenditures to date:	$3,334	Is project on schedule?	Yes
Available Amount:	$11,666	Advantage No.:	R057816P
Percent complete through 6/30/05	20%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

The IRS and the State of Arizona allow diesel used for farm, construction, or other off-road use to be purchased tax-free. This tax-free diesel must be dyed red to identify it as off-road diesel and fuel suppliers must report their sales of dyed diesel on a monthly basis. Because about one-third of the retail price of diesel is tax, there is motivation to inappropriately use dyed diesel in on-road vehicles. The on-road use of dyed diesel deprives the State of highway tax revenue and in August, 2002, ADOT initiated federally funded education and enforcement efforts to decrease inappropriate (i.e., on-road) use of dyed diesel.

The current education and enforcement efforts are resulting in the collection of taxes and penalties, but the ultimate program goal of decreasing the on-road use of dyed diesel cannot currently be evaluated. Currently there are no indicators of what impact the education and enforcement program has on on-road dyed diesel use. The needed indicators can be developed from an analysis of ADOT fuel supplier report data. In addition, ADOT counterparts at the IRS engage in similar education and enforcement efforts. The IRS has agreed to provide access to their fuel supplier data in support of this evaluation. The collaborative nature of this project will result in the creation of robust program effectiveness measures.

RESEARCH OBJECTIVES

1. Identify valid measures of effectiveness for dyed diesel education and enforcement efforts.
2. Evaluate the effectiveness of the dyed diesel education and enforcement efforts.
3. Identify opportunities for improving the effectiveness of education and enforcement efforts.
4. Identify strategies for improving the effectiveness of education and enforcement efforts.

Planning and Administration

EXPECTED IMPLEMENTATION

The Arizona Transportation Research Center (ATRC) will conduct the research with the assistance of one or more university graduate students. ADOT management will determine which improvement strategies to pursue.

The research will result in knowledge that will allow ADOT to evaluate and improve dyed diesel education and enforcement efforts. ADOT MVD will be the process owner.

STATUS OF THE RESEARCH

The project is underway.

TECHNICAL ADVISORY COMMITTEE (TAC)

Director, MVD: Stacey K. Stanton
Deputy Director, ADOT: David Jankofsky
MVD MC & TS: Kathy Morley
MVD Revenue Accounting: John Tisdel
Fuel Tax Evasion Unit: Timothy Lee
FHWA: Karen King
ATRC: John Semmens

Project 579, FY 2004

Making a Good First Impression: Improving PreDesign and Environmental Public Information

Research Agency:	Data Methods	Program Date:	10/01/04
Principal Investigator(s):	Robert Done	Contract Date:	08/11/04
Contract Amount:	$14,820	Original Completion Date:	12/31/05
Program Budget:	$15,000	Estimated Completion Date:	12/31/05
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$15,000	Advantage No.:	R057916P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

From project scoping through ADOT's initial investigations into project viability, the public receives its first opportunity to review and comment upon potential projects. This exposure forms a first impression of ADOT's professionalism; its accountability toward accepting desired design concepts; and setting an appropriate standard for final design and, ultimately, construction.

Needed is a more refined and consistent approach for seeking public involvement and for positioning ADOT as an accountable professional services provider dedicated to bettering Arizona's transportation systems and its citizens' quality of life through extensive public information and community relations programs.

RESEARCH OBJECTIVES

1. Identify how ADOT customers are introduced to potential future projects by defining the roles of PreDesign Project Managers, Environmental Planners and Engineering Consultants.
2. Identify types of public notification and methods used to gain and implement public involvement as project development advances prior to the initiation of final design to specifically determine how ADOT customers are to remain informed and involved during the process.
3. Determine the potential benefits of assigning a full-time Public Information Project Manager to conduct customer relations during the initial stages of the project introduction and the concomitant public involvement process that occurs prior to initiation of final design.

EXPECTED IMPLEMENTATION

The research will result in knowledge that will allow ADOT to improve its PreDesign processes. The ADOT Community Relations Office will be the process owner.

The research will result in knowledge that will allow ADOT to evaluate and improve dyed diesel education and enforcement efforts. ADOT MVD will be the process owner.

STATUS OF THE RESEARCH

The project is underway.

TECHNICAL ADVISORY COMMITTEE (TAC)

Doug Nintzel
Matt Burdick
Mark Bonan
Mary Viparina
Vince Li
Shannon Wilhelmsen
Ginger Murdough
William Vachon
John Semmens

Planning and Administration

Project 580, FY 2004

Barcode Inventory System

Research Agency:	BarScan	Program Date:	10/01/04
Principal Investigator(s):	Andy Schiffler	Contract Date:	08/18/04
Contract Amount:	$9,800	Original Completion Date:	12/31/05
Program Budget:	$15,000	Estimated Completion Date:	12/31/05
Expenditures to date:	$3,969	Is project on schedule?	Yes
Available Amount:	$11,031	Advantage No.:	R058016P
Percent complete through 6/30/05	50%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

The current annual inventory process relies completely on personnel and handwritten documentation. Human error and a lengthy documenting process is not cost effective or time productive. With this process relying on written tracking method multiple items that are listed as lost are usually located in another office, sent to surplus or in storage.

ADOT needs to research the availability of a bar code tag printer, hand held scanners and a software program to accommodate the information. This program could track items as they are received, sent to surplus, storage throughout the year instead of annually.

RESEARCH OBJECTIVES

1. Assess barcode technology and its cost-effectiveness for conducting ADOT inventories.
2. Install a barcode system as a pilot project and collect data on its effectiveness.
3. Determine whether barcode technology should be implemented organization-wide in appropriate settings.

EXPECTED IMPLEMENTATION

ATRC will conduct the research in two phases. One phase will consist of pre-installation analysis of options. The other will consist of equipment acquisition and installation and evaluation of results.

The research will provide data that could be used to achieve more effective inventory measurements/audits. The ADOT Process owner would be Fixed Assets section of ADOT.

STATUS OF THE RESEARCH

The project is underway.

Planning and Administration

TECHNICAL ADVISORY COMMITTEE (TAC)

Richard Neshwat	Fixed Assets
Theresa Simms	FMS
Tanya Shearrow	FMS
Craig Rudolphy	FMS
Robyn Caillouette	MVD
Virginia Manley	MVD
Stanley Soesilo	ITG
Karen King	FHWA
John Semmens	ATRC

Planning and Administration

Project SPR 582 FY 2005

Multi Modal Use of Freeway Corridors

Research Agency:	Lee Engineering	Program Date:	10/01/04
Principal Investigator(s):	Brennan Kidd	Contract Date:	11/24/04
Contract Amount:	$14,975	Original Completion Date:	12/31/05
Program Budget:	$15,000	Estimated Completion Date:	12/31/06
Expenditures to date:	$675	Is project on schedule?	Yes
Available Amount:	$14,325	Advantage No.:	R058217P
Percent complete through 6/30/05	20%	Responsible ATRC Staff: (T&S Project Manager)	John Semmens

PROBLEM STATEMENT

Sharing freeway or state highway corridors with transit systems could have benefits related to transportation system planning and also cost savings. While aspects of this problem have been studied, a comprehensive compilation of current practices and research that would relate to Arizona is not available. This information would improve the State's ability to develop cost effective transit solutions.

The research would develop strategies, which ADOT could implement for the multimodal optimization of urban freeway corridors that stimulate growth-induced demands for mobility. Roles of major participants in the development and funding of these strategies should be included.

The results of this research will assist transportation planners in developing long-term transit systems and likely save Arizona tax dollars by enabling the creation of lower cost transit systems.

RESEARCH OBJECTIVES

1. Identify those practices that emulate the urban form, funding opportunities and legal environment of Arizona.
2. Present several implement able alternatives.
3. Obtain funding estimates from other states for the incremental costs to design high-capacity transit within a corridor and the costs to build such systems in a new facility vs. retrofitting an existing freeway corridor.

EXPECTED IMLEMENTATION

The research will result in information that could be used to guide a more effective multi-modal program in Arizona.

Planning and Administration

The ADOT Public Transportation Division and the Communications and Community Partnerships Group will use the results of this research to facilitate their work related to transit planning.

STATUS OF RESEARCH

This research is underway.

TECHNICAL ADVISORY COMMITTEE (TAC)

Sam Chavez	PTD
Jim Dickey	PTD
Mary Viparina	ITD
Kathleen Sommer	TPD
Shannon Wilhelmsen	C&CP
Cherie Campbell	PAG
Karen King	FHWA
John Semmens	ATRC

Planning and Administration

Project 583, FY 2004

Open Source Software Study

Research Agency:	Mind Matrix	Program Date:	10/01/04
Principal Investigator(s):	Apurba Borah	Contract Date:	08/11/04
Contract Amount:	$15,000	Original Completion Date:	12/31/05
Program Budget:	$15,000	Estimated Completion Date:	12/31/05
Expenditures to date:	$675	Is project on schedule?	Yes
Available Amount:	$14,325	Advantage No.:	R058016P
Percent complete through 6/30/05	15%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

ADOT currently spends over 1 Million dollars annually for software licenses, software maintenance, and support contracts for software in the enterprise. This covers both software on the desktop and server software. Open source software (OSS) such as the Linux operating system, Apache web server, Sendmail mail server, Open Office office suite, etc are all examples of stable, secure, reliable, and free software packages which could possibly replace existing commercial off-the-shelf (COTS) software.

RESEARCH OBJECTIVES

1. Determine where open source software may fit into the ADOT enterprise to replace current COTS software or add new functionality not covered by existing software.
2. Examine the benefits and risks of using OSS vs. COTS software within ADOT.
3. Estimate cost savings (Direct and Indirect) of utilizing OSS software within ADOT.

EXPECTED IMPLEMENTATION

ATRC will conduct the research with the assistance of one or more university graduate students. ADOT management will decide whether to adopt a new software standard.

This research will give ADOT an understanding of the expected costs, benefits, and risks involved with implementing OSS in the enterprise. ADOT will gain experience in OSS through piloting one or more applications to better understand some of the intangibles involved. ITG will be the process owner.

STATUS OF THE RESEARCH

The project is underway.

Planning and Administration

TECHNICAL ADVISORY COMMITTEE (TAC)

ITG: Jamie Rybarczyk
ITG: Wes Bateman
FHWA: Karen King
ATRC: John Semmens

Planning and Administration

Project 598, FY 2005

Analysis of Bicycle Lanes (BL) Versus Wide Curb Lanes (WCL)

Research Agency:	Arizona Transportation Research Center	Program Date:	10/01/05
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	12/31/06
Program Budget:	$15,000	Estimated Completion Date:	12/31/06
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$15,000	Advantage No.:	R059817P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

ADOT Bicycle Policy (MGT 02-01) became effective 3/1/02 and is scheduled for review (refer to http://adotnet/divisions/itd/pnp/PDF/MGT/mgt021.pdf). Excerpts from that policy state that it is ADOT's policy:

- Provide shared roadway cross-section templates;
- Consider, as a part of major new construction and major reconstruction in urban areas, Wide Curb Lanes up to 15' in width; and
- Consider bicycle lanes for inclusion with major new construction or major reconstruction when: 1) fully funded for construction and maintenance by a local agency AND 2) the bicycle lane is included as a part of a planned designated bicycle route approved by ADOT.

What is the appropriate type of bicycle facility on the State Highway System for cyclists? Some research, for example, concludes that: 1) BL cause problems to the extent that they encourage bicyclists and motorists to violate the rules of the road for drivers of vehicles, or 2) the best way to make most busy roads "Motorist Friendly in the Presence of Bicyclists, Resulting in Bicycling Friendliness" is to provide WCL, that they are simple, and simply better. The counterargument is that cycling is much safer and more popular precisely in those countries where bikeways, bike lanes, special intersection modifications, and priority traffic signals are the key to their bicycling policies. Finally, some studies conclude that both BL and WCL facilities can and should be used to improve cycling conditions.

RESEARCH OBJECTIVES

1. To provide a report that can be used by ADOT engineers to select the appropriate design to accommodate bicycle travel AND to help ADOT answer legitimate concerns while rebuffing unwarranted outside pressure to deviate from sound engineering practice.

EXPECTED IMPLEMENTATION

ATRC will conduct the research with the assistance of one or more university graduate students. ADOT management will determine whether to implement any changes in bicycle accommodation.

The research will result in data indicating which designs for accommodating bicyclists are most appropriate. The Transportation Planning Division of ADOT would be the process owner.

STATUS OF THE RESEARCH

The project is not yet underway.

TECHNICAL ADVISORY COMMITTEE (TAC)

TPD: Dale Buskirk
TPD: Mike Sanders
Roadway Engineering: Mary Viparina
Traffic: Richard Moeur
ITD: Kenneth Cooper
DPS: Mike Orose
FHWA: Karen King
ATRC: John Semmens

Planning and Administration

Project 599, FY 2005

Transit Travel Study

Research Agency:	Arizona Transportation Research Center	Program Date:	10/01/05
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	12/31/06
Program Budget:	$20,000	Estimated Completion Date:	12/31/06
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$20,000	Advantage No.:	R059917P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

Due to increased traffic congestion, public transit systems face many challenges to maintain normal service on major urban arterials. Fixed route transit vehicles that share streets with other vehicles. This can have a negative impact on service operations as well as overall traffic flow, depending on many factors. Appropriate strategies are needed to improve transit service on major arterials, while maintaining an optimal level of service for all traffic flow. An analysis of Tucson and Phoenix area fixed route transit systems is needed.

RESEARCH OBJECTIVES

1. Study the interaction of buses and other vehicles on major urban arterials, as well as bus access and dwell time.
2. Identify key challenges to maintaining normal bus operating speeds and overall traffic flow.
3. Develop appropriate strategies for improving bus-operating speeds while maintaining or improving overall traffic flow on major arterials.

EXPECTED IMPLEMENTATION

ATRC will conduct the research with the assistance of one or more university graduate students. State & local governments will determine whether to implement any new programs or changes in operations.

The research will result in information that could be used to improve transit operations & traffic flow on urban roadways. PTD will be the process owner.

STATUS OF THE RESEARCH

The project is not yet underway.

Planning and Administration

TECHNICAL ADVISORY COMMITTEE (TAC)

PTD: Sam Chavez
Phoenix Transit, Scott Miller
TPD: Kathleen Sommer
MAG, Eric Anderson
PAG, Tom Fisher
Sun Tran, Aimee Ramsey/Bob Magee
City of Tucson, Mike Holder
FHWA: Karen King
ATRC: John Semmens

Planning and Administration

Project 609, FY 2006

Driver education for safety in adverse driving conditions

Research Agency:	Arizona Transportation Research Center	Program Date:	10/01/06
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	12/31/07
Program Budget:	$50,000	Estimated Completion Date:	12/31/07
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$50,000	Advantage No.:	R060918P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

Under certain adverse and unavoidable driving conditions, often times the driver of a vehicle gets confused, and ends up taking wrongful action leading to severe crashes. For example, a tire blow out in the middle of a high speed facility, driving during a dust storm, driving behind a large truck, running off the road, sudden bottleneck or emergency vehicles on the way, etc. Not knowing what to do to avoid an impending collision with another vehicle, median, trees, utility poles, or simply rolling over, many drivers do not take the right emergency action. Any wrongful action by a single driver on a roadway facility can result in crashes of various severities involving one or more vehicles and other road users.

The objective of this research is to ascertain how to educate drivers for safety under certain adverse and unavoidable driving conditions. An improved education program is expected to reduce the number of crashes, injuries as well as reduce the severity of crashes.

RESEARCH OBJECTIVES

1. Determine the state-of-the-art practices in educating drivers for safety in certain adverse driving conditions will be reviewed and summarized.
2. Determine whether any relevant laws and regulations related to driving in the State of Arizona need to be changed.
3. Develop a realistic module of a driver education program—including the estimated cost of implementation.

EXPECTED IMPLEMENTATION

ATRC will conduct the research with the assistance of a professional consulting firm. ADOT management will determine whether to advocate any changes in existing procedures or laws. If legislation is desired, ADOT will work with the governor and legislature to draft appropriate new laws.

The results of the research will be implemented by initially developing an optional driver education program, which can eventually be converted to a mandatory program. State agencies, like DPS, GOHS, ADOT, and other local agencies interested in promoting safety, in conjunction

with any interested private agencies will be responsible for the implementation. Cost of implementation will vary depending on the extent of education, and a preliminary cost will be determined through this research.

STATUS OF THE RESEARCH

The project is not yet underway.

TECHNICAL ADVISORY COMMITTEE (TAC)

Traffic & Safety: Reed Henry, Kohinoor Kar, Jim Williams
DPS: Mike Orose
GOHS: Richard Fimbres
MVD: Cydney DeModica
TPD: Cindy Eiserman
FHWA: Jennifer Brown
Kerry Wilcoxon – City of Phoenix
Richard Nassi – City of Tucson
ATRC: John Semmens

Planning and Administration

Project 610, FY 2006

Implementing a Statewide Rideshare Program in Arizona

Research Agency:	Arizona Transportation Research Center	Program Date:	10/01/06
Principal Investigator(s):	Pending	Contract Date:	Pending
Contract Amount:	Pending	Original Completion Date:	12/31/07
Program Budget:	$50,000	Estimated Completion Date:	12/31/07
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$50,000	Advantage No.:	R061018P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	John Semmens

PROBLEM STATEMENT

Research the mobility benefits, operational logistics, and the legal aspects, and the funding options of establishing a state-level rideshare program to serve inter-regional mobility needs of employers and commuters.

RESEARCH OBJECTIVES

1. Develop an implementation plan that identifies priority corridors, mobilization issues, staffing, capital requirements, and operational issues.

2. Identify federal, state, and/or private funding options to implement the program.

EXPECTED IMPLEMENTATION

ATRC will conduct the research in two phases: (1) the literature review and identification of other state programs will be done with the assistance of one or more university graduate students, (2) the survey of employers and commuters will be done by a professional survey research firm. ADOT management will determine whether to implement any new programs. If legislation is required, ADOT will work with the governor and legislature to draft appropriate new laws.

The research will result in information that could be used to provide an affordable alternative for commuters who travel significant distances from their residence to employment centers within a region. PTD will be the process owner.

STATUS OF THE RESEARCH

The project is not yet underway.

Planning and Administration

TECHNICAL ADVISORY COMMITTEE (TAC)

Champion: Jim Dickey
PTD: Matt Carpenter, Marc Pearsall
TPD: Kathleen Sommer
FHWA: Karen King
ATRC: John Semmens
Valley Metro: Gary Roberts
Gayle Johnson Pima County

Project 493, FY 2000

Bridge Foundation Design Parameters and Procedures for Bearing in SGC Soils

Research Agency:	Arizona State University	Program Date:	7/01/99
Principal Investigator(s):	Dr. Bill Houston	Contract Date:	11/18/00
Contract Amount:	$150,000	Original Completion Date:	05/17/02
Program Budget:	$214,808	Estimated Completion Date:	11/30/04
Expenditures to date:	$214,808	Is project on schedule?	No
Available Amount:	$0	Advantage No.:	R0493 12P
Percent complete Through 6/30/05	70%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

Drilled shaft foundations support a significant portion of the bridge substructures in Arizona. These drilled shafts are commonly supported in mixed soils types known as sand-gravel-cobbles (SGC) layer and derive their capacities from side friction and end bearing in SGC layer. Current design procedures and parameters are based on uniform soil conditions. Soils medium is modeled either as clay or sand. Limited amounts of research data are available for design of drilled shafts supported in granular soils with significant gravel and cobble contents. Current American Association of State Highway and Transportation Officials (AASHTO) design method for drilled shafts in granular soils medium is based on the equations proposed by Reese and O'Neil (Federal Highway Administration (FHWA) Procedure). Meyerhoff and Kulhawy developed the other two common design procedures. Available load test data indicate that measured drilled shaft capacities tend to be larger with an increase in gravel content of the granular soils than the design capacities. Additionally, the capacity tends to increase with the increase of calcium carbonate cementation. However, definitive relationships among these variables and corresponding design parameters are not available for general design applications. Drilled shafts in mixed soils (i.e., SGC) conditions will support significant number of bridge foundations in the future. Significant savings could be realized if design parameters and procedures could be developed to account for the increase in friction of soils with the increase of gravel content and calcium carbonate cementation.

RESEARCH OBJECTIVES

1. Prepare an evaluation of the current AASHTO design methods for Drilled Shaft foundation.
2. Prepare a comparative analysis of Drilled Shaft foundations based on AASHTO design method and those based on load tests in granular soils with gravel and cobbles.
3. Evaluate the added strength of soils due to the presence of gravel and cobbles along with/without cementation in soils.
4. Recommend changes in design parameters and design procedures.

The following tasks will be performed:

1. Develop a Technical Advisory Committee (TAC).

2. Meet with TAC to prepare a Scope of Work and select a consultant.
3. Conduct a literature search on the issues of drilled shaft foundation design in granular soils.
4. Conduct an evaluation of the current AASHTO design methods for drilled shaft foundation, for their basis and limitations in regard to SGC materials.
5. Prepare a comparative study of drilled shaft capacities based on AASHTO design methods and those based on load test data in granular soils with gravel and cobbles.
6. Identify the design parameters that could be modified to account for additional capacities of drilled shaft foundation in SGC soils with and without cementation.
7. Develop design parameters and procedures for drilled shafts supported by SGC soils.
8. Prepare a memo for submittal to AASHTO Technical Committee T-15 for revision of the AASHTO procedure for design of drilled shaft foundations.
9. Document the research efforts and findings in a final report.

EXPECTED IMPLEMENTATION

The research has resulted in an evaluation of the current AASHTO design method for drilled shaft foundations based on the available load test data on drilled shafts in SGC soils. The research has provided information to be used to improve the design of drilled shaft foundations for bridges and structures.

STATUS OF THE RESEARCH

The research has been basically completed during the past year. Research work was on hold while a separate effort to initiate a related Federal Pooled Fund project was monitored. The completed final draft report has been submitted to ATRC for review before publication.

TECHNICAL ADVISORY COMMITTEE (TAC)

Dan Heller	TY Lin, Inc.
Shafi Hasan	Bridge Engineering, ADOT
J.J. Liu	Materials, ADOT
Doug Alexander	Materials, ADOT
Aryan Lirange	FHWA
Christ Dimitroplos	ATRC, ADOT

Project 510, FY 2001

Performance of Various Types of Bridge Deck Joints

Research Agency:	Michael Baker Engr.	Program Date:	7/01/01
Principal Investigator(s):	John Misik, P.E.	Contract Date:	December 2002
Contract Amount:	$99,082	Original Completion Date:	August 2003
Program Budget:	$100,000	Estimated Completion Date:	October 2004
Expenditures to date:	$82,040	Is project on schedule?	No
Available Amount:	$17,960	Advantage No.:	R0510 13P
Percent complete through 6/30/05	95%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

Each year numerous bridge deck joints must be replaced and/or repaired in the Arizona State Highway System Inventory. Certain types of bridge deck joints have failed prematurely or required extensive repairs within a very short time after installation. This is due in part, but not limited to, poor design, poor quality materials, improper engineering, faulty installation, and poor concrete quality. This has become a great concern in maintaining the state highway system, not to mention the enormous cost of replacing and/or repairing bridge deck joints. This also causes great inconvenience to the motoring public due to traffic control and closures required on an already congested highway system.

Although considerable research has been conducted in this area, most of the work deals with bridges built in other climates. The desert Southwest imposes some unique performance requirements. The area is arid, experiences large daily temperature changes, and high ultraviolet exposure. The northern portion of the state is also subjected to cold temperatures, and ice and snow control (salt and cinders) measures. The performance of bridge deck joint seals in Arizona has been evaluated and joint seal designs developed for the unique Arizona conditions. The initial research has discovered that the primary cause for bridge deck problems is in the various initial installation steps. The research is developing tools for construction and inspection to assure the deck joints are properly installed. A video is being prepared for use by construction inspectors, as their turnover rate is high.

RESEARCH OBJECTIVES

Investigate the design, performance, durability, cost effectiveness, constructability, and maintenance of existing bridge deck joints on the Arizona State Highway System.
Summarize the findings for existing bridge deck joints, with special attention paid to types of failures and the reasons for them.
In addition to existing types, analyze other alternative bridge deck joints available on the market in light of existing problems. Specifically look at the role the Southwest's climate plays in the design, performance, durability, cost effectiveness, constructability, and maintenance of bridge deck joints.

1. Provide recommendations for bridge deck joints for all the various applications utilized by the Arizona Department of Transportation (ADOT) Bridge Group on the Arizona State Highway System.

2. Produce the necessary specifications for the recommended types of bridge deck joints and concrete.

The following tasks will be performed:

1. Develop a Technical Advisory Committee (TAC).
2. Meet with the TAC to prepare a scope of work and select a consultant.
3. Conduct a brief literature search on the available bridge deck joints.
4. Investigate the design, performance, durability, cost effectiveness, constructability, and maintenance of existing bridge deck joints on the Arizona state highway system. Selected bridge joints to determine the failure modes
5. Review design, durability, cost effectiveness, constructability, and maintenance of the selected samples.
6. Evaluate other possible types of bridge deck joints available on the market to determine suitability in the southwestern climate.
7. Recommend appropriate bridge deck joints installation procedures and specifications based on sound engineering findings, that will provide long term durability, cost effectiveness, minimal maintenance with proper installation, and the least amount of inconvenience to the general motoring public.
8. Document the research effort and findings in a final report with specifications.

EXPECTED IMPLEMENTATION

The research will result in ADOT Bridge Group being able to immediately implement the recommended types of bridge deck joints, procedures and recommendations for various applications on ongoing and for future projects statewide.

STATUS OF THE RESEARCH

Engineering Consultant selected. Project about 35% completed. Literature research completed. Bridge Deck life cycle analysis completed. Research will be completed focusing on installation aides, procedures and specification recommendations.

TECHNICAL ADVISORY COMMITTEE (TAC)

Aryan Lirange	Federal Highway Administration	Jean Nehme	Bridge Group
Donald Rushton	Materials Testing Section	Dan Williams	Construction
Shawn Farahzadi	Construction Operations Section	Bob Webb	Construction
Clifton Guest	Bridge Management Section	Walter Kent Link	District
Tina Sisley	Bridge Design Section		
Pe-Shen Yang	Bridge Engineering Group		
James Pyne	T Y Lin, Inc.		

Project 538, FY 2002

High Performance Concrete for Bridge Structures in Arizona

Research Agency:	Jabar Engineering	Program Date:	10/01/2002
Principal Investigator(s):	Tarif Jabar, P.E.	Contract Date:	August 2003
Contract Amount:	$150,000	Original Completion Date:	May 2004
Program Budget:	$150,000	Estimated Completion Date:	May 2005
Expenditures to date:	$62,079	Is project on schedule?	Yes
Available Amount:	$87,921	Advantage No.:	R053814P
Percent complete through 6/30/05	35%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

In order to stimulate the use of higher quality concrete in highway structures, the Federal Highway Administration has strongly promoted high performance concrete (HPC) materials. High performance concrete has been found to be feasible in all aspects of concrete bridges including the decks, piers, and pre-stressed concrete girder cross-sections. Several studies have indicated that using concrete compressive strengths of up to 10,000 psi allowed longer span lengths and more economical structures. Many state agencies have thus saved construction time and money by using high performance concrete. One of the reasons why HPC is not regularly specified for highway structures in Arizona may be the lack of available data regarding the field use in hot and arid climates. This proposal will seek to develop and implement the use of high performance concrete in Arizona's bridges.

RESEARCH OBJECTIVES

The objectives of this research project are to evaluate the applicability of using high performance concrete in structures in Arizona and to determine any climate-related issues associated with the use of high performance concrete.

ACTION PLAN - TASKS

The researcher will accomplish the following tasks:

1. Meet with the Technical Advisory Committee to discuss the scope of work and action plan.
2. Conduct a literature and research-in-progress search and review the practice within Arizona, other departments of transportation, and throughout the industry. Prepare a state-of-the-art/state-of the practice report.
3. In addition to improved durability effects, the effect of using HPC in the deck will be evaluated on the flexural strength, ductility, pre-stress losses, and long-term deflections of the superstructure
4. Several mix designs will be developed and used in a laboratory-testing program. Performance based tests will be conducted to assess the characteristics of the materials.
5. Prepare a plan and specifications for the design and construction of a designated high performance concrete bridge project in Arizona. The plan shall include high performance concrete mixtures for the Arizona Department of Transportation Bridge Group to use for the

design of bridge columns, girders, and decks. The plan will also address the curing requirements, shrinkage cracking, strength, and toughness requirement.

6. Results will be documented and compiled as a user-manual for high performance concrete in bridge structures in hot and arid climates. A cost analysis study will be performed. Results will be used to identify possible modifications to current practice.
7. Document the research effort and findings in a final report in accordance with ATRC guidelines.

EXPECTED IMPLEMENTATION

This project will increase the acceptability of high performance concrete materials in the local community. It will help address some of the process, parameters, and design challenges faced by the bridge group in designing cost-effective, compact, and strong structures through the use of higher strength materials. By reducing extra piers and members, it may reduce the size requirements of many new and rehabilitated structures**.** The research results will be tested in specific bridge design project.

STATUS OF THE RESEARCH

Consultant contract awarded and research project underway. Literature research completed

TECHNICAL ADVISORY COMMITTEE (TAC)

Aryan Lirange	Federal Highway Administration
Jean Nehme	Bridge Group
Oscar Mousavi	Materials
Henry M. Sung	Bridge Design
Greg Lingor	Parsons Group
Shawn Farahzadi	Construction
	Construction Inspection
	District Engineer

Project 541, FY 2002

Protective Strategies and Retrofit Schemes for Concrete Bridge Decks in Arizona

Research Agency:	KPFF Engineers	Program Date:	10/01/2002
Principal Investigator(s):	Brian B. Raji P.E.	Contract Date:	August 2003
Contract Amount:	$150,000	Original Completion Date:	October 2004
Program Budget:	$150,000	Estimated Completion Date:	February 2005
Expenditures to date:	$15,079	Is project on schedule?	No
Available Funds	$134,921	Advantage No.:	R054114P
Percent complete through 6/30/05	65%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

Corrosion in reinforcing steel and the lack of concrete durability are two of the most severe deterioration problems for bridges today. Arizona has experienced both of these problems. Today, the increasing use of de-icing chemicals has been accompanied by the need for increasing attention to bridge deck maintenance and repair work. Currently, the Arizona Department of Transportation (ADOT) has 31 bridges on Interstate and State Routes requiring some kind of bridge deck rehabilitation. The cost to rehabilitate these bridge decks becomes very expensive due to the traffic controls and the adopted retrofit methods. In addition, more bridge decks need to be rehabilitated due to their aging and de-icing chemical usage. The current budget for deck repair is not adequate and ADOT needs to establish a cost-effective program to repair these deteriorated bridge decks in a systematic way with current up-to-date technologies available. A research project needs to be established to study the following topics: (1) protective strategies to minimize the deck deterioration problems and (2) cost effective retrofit schemes to rehabilitate deteriorated bridge decks.

RESEARCH OBJECTIVES

The objectives of this research project are to develop: protective strategies to minimize bridge deck deterioration and cost-effective retrofit schemes to rehabilitate deteriorated bridge decks.

Research Tasks

1. Develop a Technical Advisory Committee (TAC).
2. Prepare a scope of work and select a consultant.
3. Conduct a literature and research-in-progress search and review the practice within Arizona, other departments of transportation, and throughout the industry. Prepare a state-of-the-art/state-of the practice report.
4. Review the status of the bridge decks within the state system. Visit bridges to review the deterioration problem, meet with ADOT Maintenance personnel to discuss the repair and maintenance issues, and meet with the bridge design and management personnel to gain their perspective on the problem. Prepare a report defining the issues and problems.
5. Recommend protective strategies to minimize bridge deck deterioration, and cost-effective retrofit schemes to rehabilitate deteriorated bridge decks. These recommendations must be justified with technical data and information.

6. Develop implementation materials to incorporate these techniques, strategies, materials, procedures, etc. into ADOT practice. These implementation materials will include specifications, design guidelines, construction details and any other materials required to foster implementation.
7. Document the research effort and findings in a final report in accordance with ATRC guidelines.

EXPECTED IMPLEMENTATION

Effective protective strategies to minimize bridge deck deterioration, and cost-effective retrofit schemes to rehabilitate deteriorated bridge decks will be incorporated into ADOT practice and manuals. One bridge project rehab will be completed during the research period.

STATUS OF THE RESEARCH

Consultant selected. Research begun. Literature research completed.

TECHNICAL ADVISORY COMMITTEE (TAC)

Aryan Lirange	Federal Highway Administration
David Sikes	Maintenance
Don Rushton	Materials
Clifton Guest	Bridge Group
Pe-Shen Yang	Bridge Group
Sheng-Yung Hsu	Bridge Section
Dick Westin	The Stanley Group
	Construction
	District

Project 586, FY 2005

Earth Pressures on Cantilevered Retaining Wall

Research Agency:	Pending	Program Date:	10/01/2002
Principal Investigator(s):	Pending	Contract Date:	August 2005
Contract Amount:	Pending	Original Completion Date:	October 2005
Program Budget:	$150,000	Estimated Completion Date:	October 20005
Expenditures to date:	$0	Is project on schedule?	NA
Available Funds	$150,000	Advantage No.:	R0586 17P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (Project Manager)	Christ Dimitroplos

PROBLEM STATEMENT

A number of significant research projects related to backfill material for retaining structures have been performed over the last decade. Cohesive soil, controlled low strength materials (CLSMs), recycled tire chip soil mix and more were studied for backfill material. Neither recycled asphaltic pavement (RAP) nor recycled crushed concrete backfill mix have been included in these studies. Recently contractors on several ADOT construction projects proposed using recycled concrete materials for structure backfill behind concrete cantilever retaining walls. Contractors have claimed that recycling existing concrete material from pavement removal in the vicinity of the project and using the material for the structure backfill behind the new retaining wall construction would be a significant cost saving idea.

ADOT Geotechnical Design Section of Materials Group and Bridge Design Sections of Bridge Group are very Group are hesitant to adopt the application of the proposed backfill material because of unavailability of data for design parameters for these materials unless extensive research is performed in this area. These design parameters consist of unit weight, internal frictional angle, shear strength, permeability, compaction, moisture content etc. The amount of moisture retained in the backfill material is directly related to the permeability of backfill and will greatly affect the earth pressure acting on the wall. The gradation of the mix will also affect performance properties of the backfill material. The findings of this investigation will provide ADOT the necessary information for evaluating the proposed materials objectively. Future use of these materials is heavily dependent on the results of this research.

RESEARCH OBJECTIVES

Investigate the performance of concrete cantilever retaining walls having (1) Structure Backfill meeting ADOT's current specifications (2) Structural Backfill consisting of a mixture of recycled asphaltic concrete and virgin aggregate material (3) Structural Backfill consisting of a mixture of recycled Portland Cement Concrete and virgin aggregate material.

1. Identify appropriate blend percentages for mixtures containing recycled and virgin aggregate materials.

2. Identify quality and gradation requirements for the above backfill materials
3. Establish backfill drainage and compaction criteria.
4. Investigate earth pressure and pore water pressure on wall face.
5. Examine the effect on backfill settlement, including long-term effects if any.

RESEARCH TASKS

1. Develop a Technical Advisory Committee (TAC).
2. Meet with TAC to prepare a scope of work and select a consultant.
3. Conduct a brief literature search on the topic of structural backfill for retaining walls, including the use of recycled materials.
4. Select and establish sample mixes for each of the types of backfill materials mentioned in Research Objectives.
5. Conduct necessary soil tests in order to obtain design parameters for the selected backfill sample mixes so that unit weight, internal frictional angle, shears strength, etc. can be determined. Evaluate the affect of time and temperature on the engineering properties and performance of Structural Backfill materials containing RAP.
6. Provide performance curves for the relevant design parameters as a function of blend percentage to justify an allowable maximum amount of recycled material in structural backfill.
7. Document the research effort and findings in a final report. The report should enable ADOT to evaluate the benefit of using recycled concrete materials versus conventional backfill materials.
8. Develop specifications, placement procedures/conditions, and evaluate testing requirements/feasibility for controlling the use of these materials.
9. If the finding indicates that using recycled concrete backfill materials for concrete cantilever retaining wall has the advantage in cost and quality over the conventional structural backfill material, ADOT Bridge Group will evaluate whether redesigning of the ADOT standard retaining wall is warranted.

EXPECTED IMPLEMENTAION

This research will provide the technical information to ADOT with which to accurately evaluate the quality and value of using a variety of concrete backfill mixes that are proposed by contractors.

STAUS OF RESEARCH

This research has not yet begun.

TECHNICAL ADVISORY COMMITTEE

(Proposed) Scott Weinland, Regional Materials; Henry Sung, Bridge Group; John Ivanov, Materials Group; Christ Dimitroplos, ATRC; James Wilson, Materials Group,

Project 558, FY 2003

High-Risk Crash Site Identification in Arizona

Research Agency:	University of Arizona	Program Date:	10/01/03
Principal Investigator(s):	Simon Washington	Contract Date:	February 2003
Contract Amount:	$65,000	Original Completion Date:	November 2004
Program Budget:	$65,000	Estimated Completion Date:	November 2005
Expenditures to date:	$43,071	Is project on schedule?	Yes
Available Amount:	$21,929	Advantage No.:	R055815P
Percent complete through 6/30/05	80%	Responsible ATRC Staff: (T&S Project Manager)	Yongqi Li

PROBLEM STATEMENT

Identification of high-risk crash sites is a difficult task that has received much attention in the literature. Because of the random fluctuation of crashes from year to year, a crash site may 'appear' to represent a relatively high risk in a given year when in fact the site's underlying, inherent risk level is average or below.

Previous methods rely on simple ranking of crash rates, which is problematic since rates are not linear functions. This can produce false positive indications and may lead to fixing of safety problems at locations not requiring remediation. Corrections to this 'regression to the mean' bias are often needed to account for the temporal fluctuation in crashes from year to year. Bayesian techniques, by accounting for both crash history and expected crashes for similar sites, have been shown to offer improved ability to identify 'high-risk' sites.

Many DOT's face significant liabilities in regard to high-risk site identification and subsequent safety improvements. Because state-of-the-practice methods involve corrections for regression to the mean by Bayesian analysis, and since traditional ranking methods have been shown to do a poor job of identifying the truly high-risk sites, there is a significant need for this research.

This research project will focus on improving existing procedures for identifying 'high-risk' crash sites in Arizona. By using the recently released *Arizona Local Government Safety Project Analysis Model* (Carey, 2001) as a starting point, the focus will be on improving the predictions and ranking of hazardous sites from this model.

Through this research, ADOT will obtain the following positive results:

- Identification of 'high-risk' locations on ADOT facilities.
- Suggested refinements to the Arizona Local Government Safety Project Analysis Model.
- Validation and improvement of the Arizona Local Government Safety Project Analysis Model for ensuring that efficient safety investments are made in Arizona.

RESEARCH OBJECTIVE

The project has three primary objectives:

Traffic and Safety

1. To identify 'high-risk' sites using the latest technically correct and accepted methodology in Arizona (sites to be selected by ADOT - rural two-lane highway, urban freeway, etc.)
2. To assess and validate the predictive performance of the *Arizona Local Government Safety Project Analysis Model* for identifying 'high –risk' locations.
3. To provide recommended improvements to the *Arizona Local Government Safety Project Analysis Model*, so that efficient safety investments can be made in Arizona.

The following tasks will be performed:

1. Apply the state-of-the-practice methods to hot-spot identification in Arizona. Coordinate this research with ADOT to prioritize needs and to identify the facilities for analysis (rural two-lane highways, urban freeways, interstates, etc.)
2. Review *Arizona Local Government Safety Project Analysis Model* for technical deficiencies (currently does not do a Bayesian correction for regression to the mean).
3. Assess the predictive performance of the *Arizona Local Government Safety Project Analysis Model* on the data selected in step 1.
4. Compare the results of the *Arizona Local Government Safety Project Analysis Model* to the state-of-the-practice methods applied in step 1.
5. Identify potential improvements to the *Arizona Local Government Safety Project Analysis Model*, so that future identification of 'high-risk' sites will be improved.
6. Make a recommendation to the TAC on the benefits and/or improvements of this model, and prepare a detailed implementation plan.
7. Prepare a final project summary report for ADOT in accordance with ATRC guidelines.

EXPECTED IMPLEMENTATION

This project is expected to provide tangible research results that may justify its long-term adoption by ADOT. It will demonstrate the benefits of state-of-the-practice Bayesian methodologies, as compared to the current analytical models, to more effectively identify high-risk sites for corrective safety measures.

The benefits to the State from this research would include:

- More accurate prioritization of safety concerns.
- Establishment of a "best defense" in liability cases.
- Improved safety investment efficiency (public investment).
- Reduced fatalities, injuries and property damage.

STATUS OF THE RESEARCH

A consultant was selected in April 2003 and the project research is underway.

TECHNICAL ADVISORY COMMITTEE (TAC)

Jennifer Brown	Federal Highways Administration		
Reed Henry	ADOT Traffic	Shan Chen	ADOT
Jim Williams	ADOT Data	Randy Allenstein	Local Government
Sarath Joshua	MAG		
Frank McCullagh	ADOT Data		
Larry Talley	Mesa Transportation		

Project 571, FY 2004

Options for Reducing ADOT's Legal Liability Costs

Research Agency:	Pending	Program Date:	10/01/04
Principal Investigator(s):	Pending	Contract Date:	NA
Contract Amount:	Pending	Original Completion Date:	NA
Program Budget:	$40,000	Estimated Completion Date:	NA
Expenditures to date:	0	Is project on schedule?	NA
Available Amount:	$40,000	Advantage No.:	R057116P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (T&S Project Manager)	Yongqi Li

PROBLEM STATEMENT

The costs of litigation related to a variety of transportation operations is often an unanticipated cost. One major factor in the determination of legal cost is clearly an aspect of safety and how safe the facilities are technically as well as legally. Safety concerns are paramount in the design construction and operation of highway systems and related legal suits

The condition: It is not only the technical safety that brings about costs to the transportation system but, the perceived safety conditions that are subjected to legal suits that need definition. Assessing the magnitude and identifying means by which these amounts could be reduced may not only create major saving but also lead to adjustments in the administrative operations that will reduce litigation and liability costs.

RESEARCH OBJECTIVES

A. First it is proposed to determine the annual average cost of legal liability currently compared to other DOTs nationally. Research the practices and policies that provide results that bring about less liability costs. It is proposed to define the reasons for and category of the liability losses.

B. Analyze legal options and define methods and means for the most cost efficient methods of reducing liability and settling lawsuits.

C. Obtain recommendations for policy changes, law requirement or resource needs.

Anticipated Benefits: The results of such an inventory and definition of the magnitude might identify a variety of options: that more resources (lawyers) are needed to provide legal defense; that the basis for settlement of claims may need different parameters or measure, that added preparation technically could avert major legal costs or that the ADOT stands in the lead of national statistics for saving transportation funds in settlement of claims and litigation cases.

The annual cost of settlements of legal claims is about 12 million dollars annually.
Even a 10% reduction in loses would save over $1,000,000.

EXPECTED IMPLEMENTATION

A. Determine the magnitude of ADOT's legal liability losses in dollars expended on settlements, judgments, and legal services. Examine data from the most recent five years in order to estimate an annual average magnitude of these costs.

B. Compile aggregate data for all legal liability losses. Prepare case-by-case descriptions for all losses greater that a threshold amount (~ $500,000).

STATUS OF RESEARCH

This outside legal assessment of liability potential and with objectives of minimizing Risk exposure has not been previously undertaken however internal looks at policies and practices have been made and will be re-examined along with the practices and ideas found applicable in the literature research in other states.

TECHNICAL ADVISORY COMMITTEE (TAC)

Jim Redpath,	ADOT Attorney General's Office;
George Wendt,	ADOT Risk Management;
Cindy Eiserman	ADOT Risk Management;
Terry Trost	FMS Budget Group
Bruce Christianson	Arizona Department of Administration

Project SPR 591 FY 2005

High Crash Risk Unsignalized Intersections

Research Agency:	University of Arizona	Program Date:	10/01/04
Principal Investigator(s):	Dr. Wei Hua Lin	Contract Date:	October 2004
Contract Amount:	$50,000	Original Completion Date:	November 2005
Program Budget:	$50,000	Estimated Completion Date:	November 2005
Expenditures to date:	$0	Is project on schedule?	No
Available Amount:	$50,000	Advantage No.:	R059117P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (T&S Project Manager)	Yongqi Li

PROBLEM STATEMENT

Unsignalized intersections represent potential hazards not present at signalized intersections because of the priority of movement on the main road and significant speed difference as well as drivers' and pedestrians' perceptions. As a result, information such as traffic volume, highway geometric features and traffic control data is crucial to the crash analysis in addition to crash information. The current Arizona Department of Transportation (ADOT) program for identifying hazardous unsignalized intersections is challenged by the crash data limitation. For example, in some cases, one cannot tell from some crash records whether a crash occurred at a signalized-intersection or at an unsignalized intersection. The traditional analysis is further deteriorated by Regression-to-the-Mean (RTM) due to the random fluctuation of crash occurrence from year to year at a location. In other words, a short time period observation of a location may not provide a solid indication of the safety status of that location. The entire process is aggravated by the lack of staffing in terms of time and knowledge. Therefore, a systematic process is required to tackle all the aforementioned problems.

By streamlining the process, crash data can be combined with other data sources available at MAG and other jurisdictions to improve data coverage and data quality. The EB method can be adopted to overcome the RTM. Moreover, the GIS technologies can be incorporated into the process to save staff's time in data processing. For instance, routes and crashes can be overlaid with aerial photograph to provide the engineer with a better picture of the roadway configuration of a crash site. Various tools such as spot identification and corridor analysis will enhance the engineer’s ability to analyze unsignalized intersection safety problems at a project, corridor or even a network level.

RESEARCH OBJECTIVES

Develop a GIS based screening process to systematically identify high crash risk at unsignalized intersections using Empirical Bayesian (EB) approach. The process is also instrumental in analyzing and addressing the crash causes which can potentially be utilized to support the future effort in implementing the AASHTO Highway Safety Plan.
The proposed project will make various types of supplemental information for crashes easily accessible to traffic engineers. More importantly, it could potentially avoid subjective judgment

or bias in observation as a result of RTM and ensure the efficient and effective allocation of ADOT Hazard Eliminate Safety (HES) funds.
This research project will also identify the problem of the current system, compare the current system with alternative systems, and recommend further improvements and reducing construction costs. Our current databases do not contain the necessary data (i.e. approach geometrics, traffic control, volume) to do a systematic approach to improving safety at unsignalized intersections. Prepare to use safety funds from FHWA.

EXPECTED IMPLEMNTATION

The ability to identify truly hazardous intersections is crucial for the safety of the Arizona transportation system and the agencies responsible for spending safety dollars. It is important that these locations can be identified through a systematic approach. A systematic process will enable the engineers to effectively propose safety projects that will have the greatest safety impact system wide and provide management with the necessary information that the worst locations are being addressed. It is anticipated that the results of this research can be assimilated in the development of other hazardous locations such as signalized intersections, roadway segments etc.

STATUS OF RESEARCH

This research is beginning in November 2004.

TECHNICAL ADVISORY COMMITTEE (TAC)

Reed Henry,	ADOT Safety;
Jim Williams,	ADOT Safety
Jami Garrison,	ADOT
Jennifer Brown,	FHWA
Robert Maki,	Surprise City Engineer,
Larry Talley,	Mesa Traffic Studies Analyst,
Kerry Wilcoxon,	Phoenix, Traffic Safety-TE III,
Sarath Joshua	MAG

Project 592 FY 2005

Building Tribal Traffic Safety Capacity

Research Agency:	Inter Tribal Council	Program Date:	10/01/04
Principal Investigator(s):	Elizabeth Corbett	Contract Date:	October 2004
Contract Amount:	$110,000	Original Completion Date:	November 2005
Program Budget:	$110,000	Estimated Completion Date:	March 2007
Expenditures to date:	0	Is project on schedule?	Yes
Available Amount:	$110,000	Advantage No.:	R059217P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (T&S Project Manager)	Yongqi Li

PROBLEM STATEMENT

Motor vehicle crashes (MVC) are a major cause of injuries and fatalities for American Indians traveling on state highways and other roads on reservations in Arizona. According to the Arizona Department of Health Services (ADHS), from 1990-2000 the average annual mortality rate from MVC per 100,000 population was 74.3 for American Indians compared to 19.4 for African Americans, 17.9 for White non-Hispanic, 20.1 for Hispanic and 13.5 for Asians. This trend continued in 2002; the MVC mortality rate was 68.6 compared to 20.4 per 100,000 population statewide.

RESEARCH OBJECTIVES

The project objectives are to assist three (3) of twenty-one (21) tribal governments to improve their abilities to:

1). Identify hazardous highway locations, sections and elements; and

2). Develop and prioritize projects.

EXPECTED IMPLEMENTATION

Most Tribes do not have the staff, training or financial capacity to establish and maintain a safety program. This research will provide Tribes the guidance to develop the technical requirements needed to build this capacity. The benefits to the transportation system will be a reduction in the number of MVCs and associated deaths, injuries and property damage on reservations. Additionally creation of data collection systems will provide the state data network a vital missing elements of traffic safety statistics.

Implementation would reduce estimated economic loss from MVC fatalities for fifteen tribes, which was from 1998-2002 $575,240,000 with a total of 565 lives lost. The research would also support the federal Reauthorization legislation, which would increase safety funding for Arizona roads.

This project would assist Tribes abilities to access the FHWA national model for Tribes to compete for HES funds.

STATUS OF RESEARCH

This project is just beginning FY 2005 and is anticipated to take up to 18 months.

TECHNICAL ADVISORY COMMITTEE (TAC)

Dale Buskirk - Champion	ADOT TPD
Reed Henry	ADOT Safety
Don Sneed	ADOT TPD
Richard Powers	ADOT Globe
Margaret Baha-Walker	White Mountain Apache Tribal Council
Grant Buma	Colorado Indian Tribes
Richard Fimbres	GOHS
Kenny Hicks	HIS Environmental Services
Felipe Sanchez	San Caros Apache Tribe Planning Dept
Eleanor Strang	ADHS BMS
Don Williams	Tucson Area HIS Environmental Services
Jennifer Brown	FHWA
Bob Maxwell	BIA Branch of Roads
Todd Honyaoma	Hopi Tribal Council
Salsa Norstog	Navajo Nation DOT

Project 593, FY 2005

Development and Implementation of a Regional Safety Management Database

Research Agency:	University of Arizona	Program Date:	10/01/04
Principal Investigator(s):	Dr. Simon Washington	Contract Date:	October 2004
Contract Amount:	Pending	Original Completion Date:	June 2005
Program Budget:	$122,000	Estimated Completion Date:	December 2005
Expenditures to date:	$21,660	Is project on schedule?	Yes
Available Amount:	$100,340	Advantage No.:	R059117P
Percent complete through 6/30/05	10%	Responsible ATRC Staff: (T&S Project Manager)	Yongqi Li

PROBLEM STATEMENT

Uniform databases do not currently exist for local jurisdictions to conduct detailed safety investment studies, which severely inhibits them from applying for statewide hazard elimination funds and ultimately reducing motor vehicle related deaths, injuries, and property damage.

RESEARCH OBJECTIVES

The objective of this research is to assemble a regional crash database in the PAG metropolitan region compatible with the AZ LGPA Model that supports safety analysis efforts for MPO and COG member agencies, and enables these agencies to apply for hazard elimination funds. The research will provide a uniform regional platform for safety evaluation and data management by conducting the following tasks: 1) Assess local jurisdiction safety databases; 2) Prepare a status report; 3) Develop a Regional Databases Development Plan and Manual

EXPECTED IMPLEMENTATION

Now is the time to develop a regional safety management database. Previous work by ADOT on the AZ LGPA Model and federal emphasis on "safety conscious planning" and consistent evaluation methodology provides a unique opportunity to implement a regional platform for safety evaluation and data management.

TECHNICAL ADVISORY COMMITTEE (TAC)

Randy Allenstein	ADOT Local Government Section
Gj Anderson	Oro Valley Dept. of Trans.
Jennifer Brown	FHWA
Paul Casertano	Pima Assoc. of Governments
Karen King	FHWA
Reed Henry	ADOT Traffic Group
Mike Hicks	Tucson Dept. of Transp.
Yousef Rad	Tucson Dept of Transp.
Kohinoor Kar	ADOT Traffic Group

Traffic and Safety

Reza Karimvand	ADOT Tucson District
Scott Leska	Marana Dept of Transp.
Richard Nassi	Tucson Dept of Transp.
Bob Roggenthen	Pima County Dept. of Transp.
Jim Williams	ADOT Traffic Records Section

Project 611, FY 2006

Combining Statistical and Judgmental (Descriptive) Information for Accident Pattern Analysis

Research Agency:	Pending	Program Date:	10/01/06
Principal Investigator(s):	Pending	Contract Date:	NA
Contract Amount:	Pending	Original Completion Date:	NA
Program Budget:	$60,000	Estimated Completion Date:	NA
Expenditures to date:	0	Is project on schedule?	Yes
Available Amount:	$60,000	Advantage No.:	R061118P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (T&S Project Manager)	Yongqi Li

PROBLEM STATEMENT

In recent years several regional crash databases have been under development in Arizona for traffic safety management and evaluation. The use of statistical models based on the data from these databases has helped identify sites with high risks of accidents (hot spots). There is a need to go one step further to analyze the root cause of accidents at hot spots, because many times pure statistical information cannot reveal the cause of the problem. The proposed research will combine the statistical information with judgmental information (information that is descriptive in nature and can be obtained through collision records, site visits, surveys, etc.) to examine the similarities and dissimilarities of accident patterns at hot spots and identify the underlying factors contributing to the occurrence of these accidents.

RESEARCH OBJECTIVES

1. To select an area with a number of hot spots, and for each hot spot within the area, details of accidents will be extracted to construct the collision diagram, influence diagram, and various other analysis tools for identifying distinctive accident patterns.
2. To determine, upon identifying the distinctive accident pattern, the level of similarity by grouping accidents into different categories such as their controllability, the likelihood to occur repeatedly, the effect of traffic or non-traffic factors leading to the accident, etc.
3. To compare the results based on both statistical and judgmental information with results based on a pure statistical analysis. This would eliminate variables that are statistically significant but contribute little to the occurrence of accidents at the root cause level, or to add variables often omitted in the standard statistical analysis.

EXPECTED IMPLEMENTATION

The descriptive information identified relevant to the occurrence of accidents will be included in the GIS based accident information system currently under development. Recommendations will be made for future effort in data collection and data processing for accident analysis.

Traffic and Safety

TECHNICAL ADVISORY COMMITTEE (TAC)

Reed Henry and Kohinoor Kar (ADOT HES Team), Nancy Ann (ADOT Traffic Records Section)

Research Support Programs

SPR NO.	BUDGET ITEM	TOTAL BUDGET
110	**ATRC Library Resources**	**$ 57,367**

This budget item provides for the following services on an on-going basis:

Technical—Requests and receives new publications from federal, state, and private sources, classifies and catalogs new materials, maintains the library computer databases, maintains circulation records.

Service—Provides complete research assistance, including customized bibliographies from computer databases for Arizona Department of Transportation (ADOT) staff upon request, distributes library materials to ADOT staff, provides photocopies of articles upon request, provides interlibrary loans of books.

Public Awareness—Monitors the printing and distribution of all Arizona Transportation Research Center (ATRC) publications, coordinates the efforts taken to increase public awareness of ATRC, provides brief library presentations to ADOT staff upon request, maintains the ATRC Internet and Intranet sites.

111 AASHTO and Transportation Research Board Correlation Service **$ 109,320**

This budget item is established to enable ADOT to participate in research studies initiated by the American Association of State Highway and Transportation Officials (AASHTO), implement the results of AASHTO work, and to support the annual subscription to the Transportation Research Board (TRB) Correlation Service. Dues for participation in AASHTO's National Transportation Product Evaluation Program (NTPEP) are provided by this item.

112 Administration of Research **$ 158,936**

The budget for Administration of Research is based on the prior year's expenditures and the planned projection of activities for Fiscal Year 2002. The ATRC is responsible for initiation, technical review, coordination, and implementation of the research activities of ADOT. Other participating charges made to Administration are out-of-state travel expenses to national/regional conferences, short courses or seminars.

Other administrative costs are computer use, in-state travel, and office supplies. Research personnel are responsible for the publication of many reports derived from these activities. Payroll expenditures for secretarial service and typing are charged as overhead costs of operation of the ATRC, as well as graphic artwork and printing.

This budget item also provides for state services rendered in support of the SPR program. Examples include, but are not limited to, engineering consultant services and external/internal audits. Other costs include miscellaneous services, employee-related expenses, and membership in or support for professional organizations such as ITS America.

Research Support Programs

113 Support Staff Salaries $ 250,615

This budget item is established to provide the funding for additional staff support for the ATRC. The additional staff provides the expertise to manage and conduct research identified in the State Planning and Research (SPR) Program.

114 Technical Editing $ 31,000

This budget item provides funds for technical editing services for review and editing ATRC reports and documents.

116 Product Resource Investment Deployment and Evaluation (PRIDE) $ 205,888

The PRIDE program coordinates the review and acceptance of new products for possible use by ADOT and maintains the Approved Products List (APL). The ATRC PRIDE program administrator coordinates the program with two Product Evaluation Committees: Materials, and Traffic Control.

117 Local Technical Assistance Program (LTAP) $ 128,794

This budget item is to identify the State's portion of the LTAP undertaking for this fiscal year. Annual renewal is subject to co-sponsorship by the Federal Highway Administration (FHWA).

118 Transportation Research Quick Study (TRQS) Program $10,000

This budget item provides funds for specific research topic support.
TRQS studies are limited to budgets of $2,500 or less.

120 Pooled Fund Studies (FY 2005) $ 50,000

This budget item is established to enable ADOT to participate in both national and regional Pooled Fund Studies. A listing of these projects may be found in the Pooled Fund Programs section of this document.

Research Support Programs

124 Research Traffic Data Collection $ 264,128

This project is supports traffic data collection and monitoring for the Long Term Pavement Performance (LTPP) program. Arizona is an active participant in the LTPP program. Under this project, ADOT has constructed 111 test sections in support of the Specific Pavement Studies (SPS), 25 test sections in support of the General Pavement Studies (GPS), and 52 test sections in support of LTPP's innovative materials research. Vital to the successful outcome of this research is the simultaneous monitoring and evaluation of traffic on these experiment sections. Resources under this project are employed towards the establishment of data collection sites (automatic vehicle classification and high speed weigh-in-motion), operation, maintenance and regular calibration of the sites, data evaluation, and data management.

125 NCHRP $600,000

The National Cooperative Highway Research Program (NCHRP) is an applied, contract research program that develops near-term, practical solutions to problems facing transportation agencies.

127 Small Budget Studies $131,000

Since 1997, 28 small budget projects have been completed by the Arizona Transportation Research Center (ATRC). The quality of work on these projects has ranged from good to outstanding. The student research program has been a good value for the Arizona Department of Transportation while also providing an opportunity for students to learn useful skills while earning money to support their education. The Research Steering Committee has authorized an annual allotment of $100,000 specifically designated for student research projects.

999 Special Projects/Contingency $695,450

This item is included to enhance Research Program management and will be used to fund change orders in on-going research studies and initiate new studies developed during the program year.

Pooled Fund Projects

Project No.	National Studies	Obligated Amount	Project Manager	Status
SPR-2(146)	Testing of Roadside Safety Systems	0	None	Inactive
SPR-2(187)	Safety Hardware Crash Tested to NCHRP Report 350	(1)	Steve Owen	Active
SPR-2(207)	Transportation Management Center (TMC) Study	(2)	Steve Owen	Active
SPR-3(020)	ENTERPRISE	$292,743	Steve Owen	Active
SPR-3(064)	Developing a National Strategic Plan for Advanced Construction and Maintenance		Steve Owen	Complete
SPR-3(072)	Internal Stability Design of MSE Walls	$10,000	Christ Dimitroplos	Active
SPR-3(077)	Wiremesh and Cable Mesh Slope Protection	$5,000	Tom Kombe	Active
TPF-5(004)	Long Term Pavement Performance (LTPP) Specific Pavements Study (SPS) Traffic Data Collection	$300,000	Tom Kombe	Active
TPF-5(012)	The National I-10 Freight Corridor: A Feasibility Study to Improve Freight Movement	(3)	John Semmens	Complete
TPF-5(017)	WASHTO-X Technology Transfer Initiative	$20,000	Frank Darmiento	Active
TPF-5(036)	Maintenance Quality Assurance Peer Exchange	$5,000	Yongqi Li	Active
TPF-5(037)	Southeast Superpave Center	$105,055	Christ Dimitroplos	Active
TPF-5(085)	Transportation Security Plan	$25,000	John Semmens	Complete
TPF-5(099)	Evaluation of Low Cost Safety Improvements	(4)	Yongqi Li	Active

(1) $50,000 provided by the Traffic Group
(2) $100,000 provided by the Transportation Planning Division
(3) $400,000 provided by ADOT
(4) $90,000 from Hazard Elimination and Safety funding

For additional information on these pooled fund projects see the Internet at: www.pooledfund.org

Pooled Fund Projects

Pooled Fund Project SPR-2(146)

Testing of Roadside Safety Systems

Lead Agency:	Federal Highway Administration		
ADOT Funds Obligated:	0	Technical Representative:	None
ATRC Current Funding:	0	ATRC Project Manager:	None

OBJECTIVES

To do custom Crash Testing for States that request FHWA's assistance in getting their roadside safety hardware tested. The State must be willing to pay for the testing, however the cost may be shared by other States.

STATUS

Inactive

Pooled Fund Project SPR-2(187)

Safety Hardware Crash Tested to NCHRP Report 350

Lead Agency:	Federal Highway Administration		
ADOT Funds Obligated:	$50,000	Technical Representative:	Steve Owen
ATRC Current Funding:	0	ATRC Project Manager:	Steve Owen

OBJECTIVES

This study will crash test various types of roadside safety hardware in accordance with the recommended procedures in NCHRP 350.

STATUS

Active. Routed wood blockouts for steel post guardrails were tested and developed. Oregon 3-rail bridge rail tested to Test Level Four (TL-4) in NCHRP 350, W-beam on strong steel post guardrail with a curb was tested to TL-3. An all-steel blockout and two adjustable height blockouts have been designed. An e-mail status report and ballot will be sent to the State representatives.

Pooled Fund Projects

Pooled Fund Project SPR-2(207)

Transportation Management (TMC) Center Study

Lead Agency:	Federal Highway Administration		
ADOT Funds Obligated:	$100,000	Technical Representative:	Manny Agah
ATRC Current Funding:	0	ATRC Project Manager:	Steve Owen

OBJECTIVES

The goal of the TMC pooled fund study is to assemble regional, state, and local transportation management agencies and the Federal Highway Administration (FHWA) to (1) identify human-centered and operational issues; (2) suggest approaches to addressing identified issues; (3) initiate and monitor projects intended to address identified issues; (4) provide guidance and recommendations and disseminate results; (5) provide leadership and coordinate with others with TMC interests; and (6) promote and facilitate technology transfer related to TMC issues nationally.

STATUS

Nineteen projects have been initiated or completed based on available funds to address the needs of the participating members. Currently, thirteen additional projects are proposed for consideration and selection as future TMC PFS projects. Members of the TMC PFS met in June 14 and 15, 2005 to discuss and prioritize projects for 2006. An overview of current and future TMC PFS activities is available at the TMC pooled fund study website at: http://tmcpfs.ops.fhwa.dot.gov

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Pooled Fund Project SPR-3(020)

IVHS Study (ENTERPRISE)

Lead Agency:	Iowa Dept. of Transportation		
ADOT Funds Obligated:	$292,743	Technical Representative:	Manny Agah
ATRC Current Funding:	$50,000	ATRC Project Manager:	Steve Owen

OBJECTIVES

To investigate and promote intelligent vehicle highway safety (IVHS) approaches and technologies that are compatible with other national and international IVHS initiatives.

STATUS

ENTERPRISE project reports may be accessed at the Web site: www.enterprise.prog.org

Pooled Fund Projects

Project SPR-3(064)

Developing a National Strategic Plan for Advanced Construction and Maintenance

Lead Agency:	California Dept. of Transportation		
ADOT Funds Obligated:	0	Technical Representative:	None
ATRC Current Funding:	0	ATRC Project Manager:	Steve Owen

OBJECTIVES

The objectives are to: (1) Identify ACMS improvement possibilities, (2) identify user and industry needs, (3) identify variations in need between jurisdictions, (4) analyze common needs within the variations, (5) investigate technology solutions matching with needs, (6) identify the research priorities, (7) deployment plan for developed solutions.

STATUS

Project complete.

Project SPR-3(072)

Internal Stability Design of MSE Walls

Lead Agency:	Washington State Dept. of Transportation		
ADOT Funds Obligated:	$10,000	Technical Representative:	Christ Dimitroplos
ATRC Current Funding:	$10,000	ATRC Project Manager:	Christ Dimitroplos

OBJECTIVES

Phase 5 will 1) construct and test two full-scale walls with non-select fill, 2) update the report on the physical testing of walls 1 through 11 (tested in phases 1 through 4) based on the experience with the instrumented SR 18 walls in Washington state, and 3) update the numerical modeling of walls 1 through 11 and carry out a parametric analyses.

Phase 6 will 1) construct and test one full-scale wall with non-select fill, 2) perform data reduction, interpretation, numerical modeling, parametric analysis, and report on the physical testing of the two walls constructed in Phase 5, 3) perform data reduction, interpretation, numerical modeling, parametric analysis, and report on the physical testing of the wall constructed in Phase 6, 4) investigate the effect of material type on in-soil stiffness, 5) update the K-Stiffness method based on results from the walls constructed in Phases 5 and 6 and to include seismic design, and 6) produce a final report on Phases 1 through 6.

STATUS

Phase 5 is scheduled to begin in the summer of 2005 and continue through late 2006. Phase 6 will begin in late 2006 and is planned to finish in December of 2008. Additional funds are currently being solicited to complete the work.

Pooled Fund Projects

Pooled Fund Project SPR-3(077)

Wiremesh and Cable Mesh Slope Protection

Lead Agency:	Washington State Dept. of Transportation		
ADOT Funds Obligated:	$5,000	Technical Representative:	None
ATRC Current Funding:	$5,000	ATRC Project Manager:	Tom Kombe

OBJECTIVES

Draped wire mesh and cable mesh slope protection has been utilized by states for many years to control rock fall. The initial design and specifications for these draped wire mesh slope protection systems were developed using empirical methods by WSDOT in the late 1950's for slopes that were generally less than 75 feet in height. Over the years the draped wire mesh slope protection designs have been modified by other states so that nationwide we now have a large number of variations of designs, none of which have been quantified.

STATUS

The project is nearing completion and the final report is being distributed to TAC members. The design guidelines are being implemented and are being presented at geotechnical workshops across the nation.

Pooled Fund Projects

Pooled Fund Project TPF-5(004)

Long Term Pavement Performance (LTPP) Specific Pavements Study (SPS) Traffic Data Collection

Lead Agency:	Federal Highway Administration		
ADOT Funds Obligated:	$300,000	Technical Representative:	Tom Kombe
ATRC Current Funding:	$300,000	ATRC Project Manager:	Tom Kombe

OBJECTIVES

The goal of this study is to improve the quality and quantity of monitored traffic data (volumes, classifications, and weights) on the LTPP SPS -1,-2,-5,-6 and -8 projects. A core objective of the SPS studies is to understand and quantify the relationship between pavement performance, truck volumes, and axle loadings.

STATUS

This is a two-phase project. Phase I involves assessing, evaluating, and calibrating Weigh-In-Motion (WIM) systems at the SPS sites. Phase II involves procuring, installing, repairing, and maintaining the WIM equipment at the test sites.

The Phase I contract was awarded August 2003. Phase II contract was awarded in the early part of 2005 and work is currently ongoing. As par to of the Phase II effort, contractor representatives (IRD) inspected Arizona SPS 1, SPS 2, and SPS 5 sites in July 2005 and made site recommendation in a subsequent report.

Although work is underway, States are still welcomed and encouraged to join this project. Visit the LTPP pooled fund project website at **http://www.fhwa.dot.gov/pavement/ltpp/spstraffic/index.cfm** or contact Ms. Walker for details.

Pooled Fund Projects

Pooled Fund Project TPF-5(012)

The National I-10 Freight Corridor: A Feasibility Study to Improve Freight Movement

Lead Agency:	Federal Highway Administration		
ADOT Funds Obligated:	$400,000	Technical Representative:	None
ATRC Current Funding:	0	ATRC Project Manager:	John Semmens

OBJECTIVES

The goal is to enhance the flow of freight on the I-10 corridor on an interstate, as well as on international trade levels. The study will determine whether deploying a broad range of alternatives to facilitate the movement of goods along the I-10 corridor, such as capacity enhancements, operational alternatives, and/or others, would achieve the anticipated economic growth within the states.

STATUS

Complete

Pooled Fund Project TPF-5(017)

WASHTO X Technology Transfer Initiative

Lead Agency:	Utah Dept. of Transportation		
ADOT Funds Obligated:	$20,000	Technical Representative:	Frank Darmiento
ATRC Current Funding:	$20,0000	ATRC Project Manager:	Frank Darmiento

OBJECTIVES

Expand the successful Tel-8 program to the WASHTO states. Tel-8 is a videoconferencing network of State DOTs gathered for the purpose of exchanging information and experiences on selected topics. Anticipated benefits for the newly involved states are similar to the benefits currently being realized by the states participating in Tel08: Increased low-cost interaction and information sharing between peers on topics important to the state DOTs. The expansion of Tel-8 will allow for greater selection of topics and additional state participation.

STATUS

Project is active. Web site at: www.washto-x.org

Pooled Fund Projects

Pooled Fund Project TPF-5(036)

Transportation Asset Management Research Program

Lead Agency:	Wisconsin Dept. of Transportation		
ADOT Funds Obligated:	$5,000	Technical Representative:	None
ATRC Current Funding:	$5,000	ATRC Project Manager:	Yongqi Li

OBJECTIVES

The objective is to enable participating states to leverage limited resources in an ongoing program of synthesis, research and analysis to facilitate implementation of asset management. The intent is to supplement current national asset management research efforts of the MRUTC, prevent duplicity of existing efforts, and provide a means for regional state DOTs to share resources, technology and ideas in a coordinated environment.

STATUS

Study is in the beginning stages. State partners are still being solicited to determine study focus. Possible asset management related issues to be studied include preventative maintenance, investing strategies, and personnel utilization.

Pooled Fund Project TPF-5(037)

Southeast Superpave Center

Lead Agency:	Alabama Dept. of Transportation		
ADOT Funds Obligated:	$105,055	Technical Representative:	Christ Dimitroplos
ATRC Current Funding:	$105,055	ATRC Project Manager:	Christ Dimitroplos

OBJECTIVES

Support implementation of products of SHRP-Superpave research efforts.

STATUS

Ongoing project.

Pooled Fund Projects

Pooled Fund Project TPF-5(085)

Transportation Security Plan

Lead Agency:	Federal Highway Administration		
ADOT Funds Obligated:	$25,000	Technical Representative:	Lonnie Hendrix
ATRC Current Funding:	0	ATRC Project Manager:	John Semmens

OBJECTIVES

The purpose of this work is to provide support in the first stages of developing a comprehensive Transportation Security Plan.

STATUS

A final report Volume II: *Effective Practices in State Department of Transportation Security Planning* has been published. Lonnie Hendrix asserts that selected recommendations are being implemented.

Pooled Fund Project TPF-5(099)

Evaluation of Low Cost Safety Improvements

Lead Agency:	Federal Highway Administration		
ADOT Funds Obligated:	$90,000	Technical Representative:	Reed Henry
ATRC Current Funding:	0	ATRC Project Manager:	Yongqi Li

OBJECTIVES

The goal of the proposed research is to develop reliable estimates of the safety effectiveness of safety improvements identified as strategies in the NCHRP Report 500 Guidebooks through scientifically rigorous before-after evaluations of sites within the U.S. where these strategies are being implemented.

STATUS

This project is open to any number of participating states, independent of involvement with the lead state initiative supporting implementation of the AASHTO Strategic Highway Safety Plan. The minimum target amount of funding requested by the participating states should be $30,000-50,000 per year for three years, totaling (for all states pooled funds) $3M over 3 years. States wishing to be involved in more than one improvement area (e.g. lane departure, aggressive driving, etc.) are asked to consider increasing their contributions accordingly. FHWA will contribute $1.5M total, and additional funds will be solicited from other sources.

Experimental Projects

Experimental Projects

Federal Number	Title	Project #	Status
AZ91-352	Porous Pavement	EP	Continuing
SPS-1	Strategic Study of Structural Factors for Flexible Pavements	LTPP	Continuing
SPS-2	Strategic Study of Structural Factors for Rigid Pavements	LTPP	Continuing
SPS-3	Flexible Pavement Treatments	LTPP	Continuing
SPS-4	Rigid Pavement Treatments	LTPP	Continuing
SPS-5	Rehabilitation of Asphalt Concrete Pavements	LTPP	Continuing
SPS-6	Rehabilitation of Jointed Portland Cement Concrete Pavements	LTPP	Continuing
SPS-9	Superpave Performance	LTTP	Continuing
LTPP	Seasonal Monitoring	LTPP	Continuing
LTPP	Traffic Monitoring	LTPP	Continuing
US 60	Concrete Pavement Corridor	NA	Continuing

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Alternatively Funded Projects

Project 594, FY 2005

Flat-Tailed Horned Lizard Highway Crossing Study

Research Agency:	AZ G&F Department	Program Date:	10/01/2005
Principal Investigator(s):	Ray Schweinsburg	Contract Date:	06/15/2005
Contract Amount:	$118,400	Original Completion Date:	06/30/2005
Program Budget:	$118,400	Estimated Completion Date:	12/31/2005
Expenditures to date:	$0	Is project on schedule?	Yes
Available Amount:	$118,400	TRACS No.:	R059416P
Percent complete		Responsible ATRC Staff:	
Through 6/30/05	0%	(Project Manager)	Tom Kombe

PROBLEM STATEMENT

The Arizona Department of Transportation (ADOT) faces a huge challenge in providing safe and efficient transportation to an ever-growing number of motorists, while maintaining highways that have a minimal impact on the environment. One group of wildlife that has received relatively little attention by transportation professionals and conservation biologists is amphibians and reptiles. Amphibians and reptiles are present in every ecosystem in the United States. Studies have shown that extremely high numbers of amphibians and reptiles are killed on roads in Arizona, throughout the United States, and worldwide. Although exemplary research on mitigating the effects of roads on large ungulates has come to the forefront recently in Arizona, very little is known about how to make roads more permeable for small animals like amphibians and reptiles.

This project will address some of these issues with a specific focus on providing information on the use of highway crossing structures by the Flat-Tailed Horned Lizard (FTHL) that can be applied to management decisions regarding highway design and maintenance.

RESEARCH OBJECTIVES

This project is designed to test the use of commonly employed highway crossing structures by FTHLs and provide information that can be applied to highway design and maintenance questions. The following objectives will be addressed:

1. Determine if FTHLs will pass through culverts of sizes commonly used in highway construction.
2. Compare and describe the characteristics of culverts used by FTHLs to those not used.

EXPECTED IMPLEMENTATION

Project results will provide guidance on individual project habitat mitigation efforts.

STATUS OF THE RESEARCH

A Joint Project Agreement with Arizona Game and Fish Department was signed & recorded June 15th, 2005. The project is now ongoing.

Alternatively Funded Projects

TECHNICAL ADVISORY COMMITTEE

Rene Turner - ADOT Environmental
Bill Knight - ADOT Environmental
Steve Thomas - Federal Highway Administration
Jim Rorabaugh - Fish & Wildlife Service
Bruce Eilerts – ADOT Natural Resources
Siobhan Nordhaugen – ADOT Natural Resources
Lin Piest - Arizona Game and Fish
Mike Demlong – Arizona Game and Fish
Ian Tackett – Logan Simpson Design Inc.
Tom Kombe – ADOT Research Project Manager, ATRC.

Alternatively Funded Projects

Project AZ-596, FY 2004

Evaluation of Photo Radar for Freeway Enforcement

Research Agency:	Northern Arizona University	Program Date:	10/01/03
Principal Investigator(s):	Dr. Craig Roberts	JPA Date:	11/29/04
Contract Amount (SPR):	$60,000	Original Completion Date:	8/29/05
Project Budget:	$60,000	Estimated Completion Date:	12-31-05
Expenditures to date:	$0	Is project on schedule?	No
Available Amount:	$60,000	TRACS No.:	H6704 01L
Percent complete through 6/30/05	90%	Responsible ATRC Staff: (Project Manager)	Steve Owen

PROBLEM STATEMENT

Extreme speeding on Phoenix-regional urban freeways has reached a critical level. It is technically very difficult on a multi-lane freeway to obtain accurate speed data to document the problem. A variety of ITS system(s) now exist to accurately collect such data, along with camera-based technology to effectively enforce the speed limits. Evaluation of practical ITS enforcement tools and methods is a practical, logical, and urgent step to identify ways to fight a growing safety and economic problem.

RESEARCH OBJECTIVES

ADOT needs to evaluate what kind of automated enforcement system(s) now exist to enforce speed limits on urban freeways. Deployment issues identified in other jurisdictions must be assessed. This project will assess and identify the best resources to accurately measure the freeway speeding problem, and it will fully enable a field test as a future second phase.

The project will survey other agencies, follow up with vendor contacts, review deployment issues, and develop system and plan recommendations. It will prepare a conceptual design for a trial deployment and field test, defining equipment, infrastructure, sites, and system budget. The key tasks are:

1. Conduct a comprehensive literature search and Internet search.
2. Conduct a survey of practitioner agencies (50 states, North America, global).
3. Develop vendor contacts, concept analyses, and system recommendations for testing.
4. Recommendations must consider system deployment effectiveness with regard to public perceptions and potential countermeasures by drivers and private entrepreneurs.
5. Develop a conceptual design of a trial deployment and field test, defining equipment, infrastructure, sites, and system budget.
6. Develop a conceptual field test plan with methods, locations, durations, performance measures, benefit analysis, public outreach, legislative information plan, evaluation activity budget, etc.

EXPECTED IMPLEMENTATION

Sound data is required to establish the ability, political will, and/or authorization to conduct a field test of automated enforcement systems on state freeways and highways. This research

project would provide that information, and it would fully enable a field test in a second phase, at some future point in time.

The results of this project will support the decisions needed for Arizona's leadership to then authorize and fund that field test.

STATUS OF THE RESEARCH

This project was initiated in late 2004 with a literature search. NAU worked extensively with the TAC partners to review the designs, status and results for current systems in local jurisdictions. This joint effort was intended to identify and prioritize the numerous constraints for any new speed enforcement strategy under Arizona laws.

Contacts with suppliers of automated enforcement technologies began with current Arizona system vendors, and worked progressively outward across time zones and oceans. During the spring, NAU coordinated presentations on six diverse systems for the TAC members.

From that point, work progressed to build a matrix of responses to the project's basic criteria, and to develop a Model Request for Proposal for the most appropriate concept and system for Arizona's urban freeway enforcement criteria.

None of the systems could meet every criterion for multi-lane freeway applications, but the project has effectively completed criteria development, and a draft Model RFP for use in the future as technologies rapidly evolve. The project Final Report is in progress as of June 2005.

TECHNICAL ADVISORY COMMITTEE (TAC)

Mike Manthey	State Traffic Engineer (Champion)
Tim Wolfe	Transportation Technology Group (Champion)
David Duffy	Traffic Engineering Group
Cindy Eiserman	Risk Management
Brock Barnhart	Communications & Community Partnerships
Cdr. Mike Orose	Arizona Department of Public Safety
Lisa Maxie-Mullins	Attorney General's Office
Michael Hegarty	Governor's Office of Highway Safety
Paul Porell	City of Scottsdale
Kiran Guntupalli	Maricopa Association of Governments (MAG)
Alan Hansen, Karen King	Federal Highway Administration

Alternatively Funded Projects

Project 597, FY 2005

Highway Safety Incentive Report

Research Agency:	University of Arizona	Program Date:	10/01/05
Principal Investigator(s):	Dr. Simon Washington	Contract Date:	3/28/05
Contract Amount:	$15,000	Original Completion Date:	March, 2006
Program Budget:	$15,000	Estimated Completion Date:	March, 2006
Expenditures to date:	1,770	Is project on schedule?	Yes
Available Amount:	$13,230	Advantage No.:	R059717P
Percent complete through 6/30/05	0%	Responsible ATRC Staff: (T&S Project Manager)	Yongqi Li

PROBLEM STATEMENT

Incentives are one of the strongest factors for influencing human action. Application of this factor to induce a greater effort to make roadways safer is worthy of testing.

The idea of setting up a pilot program to provide jurisdictions and/or agencies that have the opportunity to engage in efforts to make roadways safer, by saving lives is to stimulate creativity and experimentation with various initiatives and to reward those initiatives that produce positive results with financial inducements to keep up the good work. The competition for the financial rewards should encourage a more concerted effort to save lives. The rewards could induce less successful jurisdictions and agencies to adopt the methods that are proven successful elsewhere.

The net result should be a significant impact on roadway safety and the saving of dozens, if not hundreds, of lives each year from a more focused effort on behalf of safety by jurisdictions and agencies

RESEARCH OBJECTIVES

1. Supplement the fatality rate to growth developed through Phase I funding of the proposal by the Governors Office of Highway Safety.
2. Based on the fatality rates developed design an incentive program for reduction of fatalities measured against the baseline data.
3. Identify a method of for implementation of a pilot trial program for submission to FHWA nationally

EXPECTED IMPLEMENTATION

Establish an incentive program to encourage jurisdictions to create new ways to reduce projected fatality rates and receive rewards, recognition for doing so. Create a repository at the GOHS for programs that have proven results in preventing fatalities as documented by the success in each of the rewarded jurisdiction.

Alternatively Funded Projects

TECHNICAL ADVISORY COMMITTEE (TAC)
Governor's Office of Highway Safety;
Reed Henry , ADOT Traffic Group;
George Wendt, ADOT Risk Management Section;
MAG Safety Office;
FHWA;
City of Phoenix;
City of Tucson;
City of Tempe;
City of Mesa;
City of Glendale.

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